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Making Sense of the Shapes: What Do We Know About Literacy Learning in Adulthood?

Jenny C. Aker, James Berry, and Melita Sawyer

Abstract

Approximately 770 million adults worldwide are classified as illiterate, with women and individuals in sub-Saharan Africa and Southern Asia bearing the heaviest burden. Despite the potential for adult education programs to bridge this gap, such programs are often plagued by low enrollment, high dropout, and limited skills acquisition. While there is a relative paucity of economic research on adult learning as compared with primary and secondary schooling interventions, recent research in educational neuroscience and economics offers some insights into addressing the barriers to adult learning. We review these insights and offer some concrete recommendations for adult education programs in sub-Saharan Africa.

KEYWORDS
Adult education, returns to education, human capital investment
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1. Introduction

773 million adults worldwide still cannot read or write in any language, with significant costs to low-income countries (Cree et al. 2012, UNESCO 2020).[1] Policymakers and academics have focused on primary and secondary education programs worldwide, due, in part, to the argument that the rate of return made while a person is young is higher than that made at a later age (Carneiro and Heckman 2003). Despite recent cuts adult education programs, public sector spending worldwide remains significant: In India alone, the government has spent more than US$1.4 billion on the national Saakshar Bharat adult literacy campaign since 2009 (DSEL 2016, CBGA 2018, UNESCO 2016b), with similar levels of spending on adult literacy programs in Brazil. The widespread growth of these programs over the past few decades has generated hope for improving learning outcomes among adult learners, as well as increasing private and social returns (UNESCO 2009, World Bank 2010).

Despite this potential, existing evidence suggests that adult literacy programs are often characterized by low and volatile attendance, high drop-out, limited skills attainment and rapid skills depreciation (e.g. Romain and Armstrong 1987, Royer et al., Diagne 1999, Rogers 1999, Abadzi 1994, Oxenham et al. 2002, Ortega and Rodríguez 2008, Aker, Ksoll and Lybbert 2012).[2] Many of these challenges are true for primary education as well, and so the question is how learning in adulthood is unique in ways that require more adapted approaches.

The paper first provides an overview of how adults learn literacy skills, drawing upon evidence from the neuroscience, education and economics literature. We then review the current evidence of the impact of adult education programs on learning and other welfare measures, and discuss how these programs do—or do not—address barriers to learning, as well as directions for future research.

There are two overarching conclusions that emerge from our review. First, adults face multiple (and in some cases unique) barriers to learning, in particular, higher opportunity costs of their time, lower brain plasticity and higher uncertainty with respect to returns. Second, adult education programs do not necessarily address these constraints, thereby leading to relatively modest impacts of such programs on sustained learning, as well as mixed impacts on other welfare measures.

Based upon the above, we offer some more concrete lessons for adult education programs, with a particular focus on sub-Saharan Africa. First, adult education interventions need proper sequencing, moving from decoding to "automaticity" to comprehension. Second, given lower brain plasticity of adult learners, this requires more practice to make things "stick," which may require important

1 Literacy is defined as the skills of 1) "recording information of some kind in some code understood by the person making the record and possibly by other persons in some more or less permanent form; and (2) decoding the information so recorded." Similarly, numeracy is defined as "the skill of using and recording numbers and numerical operations for a variety of purposes" (J. Oxenham et al. 2002). The data in the UNESCO report uses data from "around" 2000, which could be as early as 1995 and as recent as 2005 for particular countries.

2 Abadzi (1994) found that the percentage of students passing exams in large-scale literacy programs ranged between 8% and 47%.

changes to textbooks for adult education programs. Third, for adult education skills to be sustained, it requires teaching adults how to "think about thinking"—in other words, understanding what you don't understand. Fourth, since adults have heterogeneous opportunity costs of their time—based upon age, gender, and occupational choice—these need to be built into the learning curriculum. And finally, the pedagogical approach should allow adults to identify their own educational needs and highlight their immediate relevance.

While there are a number of reviews in the education field (Kremer et al. 2013), as well as the field of educational technology, this paper offers two contributions to the existing literature. First, it specifically focuses on adult education, rather than primary school or post-secondary education, an oft-overlooked segment of educational learning. Second, while there is some recent synthesis literature on adult education programs (Blunch 2017, Thomas et al. 2020), our paper attempts to combine both theory and empirics, in an attempt to interpret the mixed impacts of adult education programs.

The remainder of the paper is organized as follows. Section 2 provides a brief introduction to the neuroscience behind the way in which adults learn, and how this is similar to (and different from) children. Section 3 assesses other constraints and factors in adult learning related to time and income, whereas Section 4 presents a review of adult education programs and their impact on learning and other welfare outcomes, whereas Section 5 compares this with the design of existing adult education programs to identify some of the potential and pitfalls. Section 6 concludes with directions for future research and outline necessary conditions and potential technological innovations for adult education programs to promote sustained learning.

2. The adult brain and literacy learning

A. How do adults learn literacy skills?

A key element of literacy learning in adulthood is "foundational learning," defined as basic skills and learning strategies. Literacy and numeracy are the core skills in foundational learning. While other types of adult learning can occur without foundational learning, these skills cbe more challenging to develop without strong foundational skills (SRDC 2014).

If literacy and numeracy are the core to foundational learning, why has acquisition of these skills received relatively little attention, especially in economics research? This may be due, in large part, to a longstanding (and outdated) assumption that adults are incapable of learning more complex skills. Since the 1970s, evidence from cognitive psychology and educational neuroscience has shown that the adult brain is capable of learning foundational skills, and that it requires sustained learning in order to prevent declines in cognitive ability.

Empirical evidence in the fields of cognitive psychology and educational neuroscience shows that while adults can learn, it is more difficult, especially for foundational skills such as reading. The human brain changes throughout life (called "brain plasticity"), responding differently to stimuli and environmental conditions over time. The brain is most responsive or "plastic" during sensitive periods in its development. Such periods are often defined as intervals when behavioral change can be maximally influenced by external stimuli, or in neural terms, when "functional plasticity is at its height and brain structure and function are most malleable" (Knowland and Donlan 2014). While these periods can occur at different times and for different durations (Knudsen 2004), the brain is considered to be the most "plastic" during early and mid-childhood, suggesting that these are optimal periods for learning and skills acquisition (Cunningham et al. 2014; Koizumi 2011).

Although the brain remains plastic to some extent throughout adulthood (Skeide et al., 2017), the dominant theory is that "brain plasticity decreases as systems become increasingly specialized towards their adult functions" (Thomas and Johnson 2008). Yet decreases in plasticity do not imply a lack of plasticity; despite decades of believing that individuals had their full set of neurons at birth, recent research has demonstrated that the adult brain is capable of making new neurons (neurogenesis), new synapses (synaptogenesis), and new capillaries (angiogenesis) if the proper stimulation is provided (Barnes and McNaughton 1985; Berkman et al. 1993; Cameron and Gould 1994; Eriksson et al. 1998; Schaie 1989).[3,4]

Literacy acquisition in adulthood can be a particular challenge, given the complexity of the task and the number of brain areas involved. For example, reading is not learned passively nor automatically, as verbal language acquisition can be; it requires instruction and studying. In other words, "We do not learn [to read] just by absorbing it from the people around us …. Children who do not learn how to read remain illiterate until they do." (Fern-Pollak and Masterson 2016). As Abadzi writes, "When neoliterates glance at a text, they often see a jumble of letters and may process only a few of their features. They must activate reading consciously and sound out each letter. The difficulties are perceptual. This phenomenon called "neoliterate adult dyslexia" (NAD)." (Abadzi 2019).

Reading is complex because it involves multiple regions of the brain, beginning with areas responsible for visual recognition of letters and words ("decoding") and culminating in brain regions that facilitate comprehension (Abadzi 2006). The neurological processes involved in each stage of reading are intricate (Fern-Pollak and Masterson 2016). For example, the initial stage of "decoding" involves changes in the left posterior brain region known as the ''visual word form area'' (McCandliss et al. 2003). Beginner readers of any age begin with recognizing letters and syllables, and processing larger graphemic units (such as words) over time (Fern-Pollak and Masterson 2016). This has been

3 Fillit et al. (2002) show that learning is related to "long-term intensification of synapse connection in the hippocampus."

4 Plasticity has also been seen in the amygdala (Ohman 2002), an area of the brain involved in social cognition, the sensorimotor cortex (Hamilton and Pascual-Leone 1998; Kujala. Alho, and Naatanen 2000) and visual pathways (de Haan, Humphreys, and Johnson 2002; de Haan, Paascalis, and Johnson 2002).

shown to be the process in many languages (Frost 2005; Ziegler and Goswami 2006), and the neural networks involved are similar across orthographies (Dehaene and Cohen 2007, Dehaene 2009).[5]

The neuroscience confirms that initial stage of decoding is difficult for an adult brain, and the adult brain may require more practice and repetition to achieve fluency with decoding. Unlike children, adults who learn to read exhibit competition in the visual word form area between face and word recognition (Dehaene et al. 2010). While the visual word form area can be "activated" over the course of literacy acquisition in adulthood (Braga et al. 2017), to decode letters and words, many adults rely heavily on executive functions, resulting in a slow and effortful process. This suggests "a limit on brain plasticity, supporting the notion that when a system has specialized … it becomes increasingly hard to re-specialize" (Knowland and Thomas 2014).

This presents a challenge to adult literacy acquisition, as strong decoding skills and word level accuracy are critical to achieving *automaticity* in reading, or "the ability to read quickly and fluently." For a child or adult reader to understand a sentence, its letters and words must be decoded quickly enough to be held in the brain's working memory, defined as a rate of one word per 1–1.5 seconds (Abadzi 2006).[6] Research suggests that adults who learned to read in adulthood read more slowly than those who learned as children, even when they were as accurate in their decoding (Dehaene et al. 2010). This implies that adults may need more time and practice with decoding than children to achieve the same level of automaticity.

Automaticity—and ultimately **reading comprehension**—may also be affected by the opacity of the language, or the level of correspondence between written units and their sounds. For example, Spanish and Italian are considered to be transparent, with "almost a one-to-one correspondence between the letters and their sounds," while languages such as Hebrew, Chinese, and Japanese are considered to be opaque (Hoare 2006, 2011). Learning to read an opaque language takes longer and requires more effort than learning to read a transparent language, regardless of age. Yet once literacy is gained, there are no significant differences in accuracy or speed across transparent or opaque languages (Fern-Pollak and Masterson 2016; Hanley, Masterson, Spencer and Evans, 2004).

5 The general outline of the cognitive developmental theory has been evolving for a number of years, (e.g., Anderson 1983, 1990; Anderson and Lebiere 1998; Fodor 1983; Forster 1979; Kintsch 1988, 1998; Perfetti 1988, 1992; Royer 1985; Stanovich 1986, 1990; van Dijk and Kintsch 1983). "The general perspective provided by such cognitive developmental theory is that the acquisition of reading skills begins with the development of phonological awareness and the ability to identify letters. Having become conscious of phonemic elements in speech and developed the capacity to recognize letters accurately, readers then begin to develop the capability of mapping phonemes onto letters and letter combinations (or spelling patterns). This ability forms the foundation for the acquisition of word-identification skills. The ability to identify words progressively improves until the identification of certain words becomes 'encapsulated', thereby enabling their automatic identification with little expenditure of cognitive resources. Students who do not develop encapsulated word-identification skills inevitably also have comprehension problems. Difficulties may range from a complete inability to comprehend because of extremely slow word decoding to very slow reading rates created by the frequent need to reread because some words have faded from working memory." (Royer et al. 2004).

6 While automaticity may be measured in the speed of reading a given sentence, this does not correctly capture the concept. Rather, it is a combination of speed and how consistently neuronal groups come together.

Given the extra time and effort required to learn opaque languages, it is not surprising that dropout rates are higher for learners of such languages, whether adults or children. Research suggests that children with reading difficulties are more likely to give up learning to read an opaque language than a transparent one (Paulesu 2006), and those who persist may never achieve high levels of automaticity (Fern-Pollak and Masterson 2016).

Beyond decoding and automaticity, comprehension is crucial for functional literacy. For this phase, metacognitive monitoring—also known as "thinking about thinking"—is critical, and helps the reader "to detect a lack of understanding so that it can be corrected" (Cromley 2005). While adults develop strong metacognitive abilities in daily life (e.g., problem-solving around work tasks), these skills do not automatically translate to reading comprehension, and is especially difficult if decoding and automaticity are not achieved.

B. What neuroscience implies for adult education programs

The body of evidence suggests that adult literacy acquisition is possible, but that programs that aim to teach adult literacy will be most successful when material is properly sequenced; adult learners are given more—and more flexible—practice; and reading is made relevant to adults' lives.

First, for adults to properly progress from decoding to automaticity to comprehension, each stage must be covered and given sufficient time. While this is not so different from learning in children, since brain plasticity diminishes with age, adults may need to "work harder" in order to "recycle" brain areas to perform a new task. This implies that explicit phonics instruction can be important for adult readers, and that the curriculum should take into consideration the "opacity" of a language. More opaque languages (and those languages that introduce new alphabets to the learner) will require more time. Existing research suggests that adolescents who struggle to read need a significant amount of instruction (up to 90 hours) to master a new reading skill (Torgesen et al. 2003). This implies that, if insufficient time is spent on early stages of literacy acquisition, then any gains acquired during class can be easily lost (Royer et al. 2004).[7]

Second, and unsurprisingly, the neuroscience literature suggests that adult education programs should be specific to the needs of adult learners rather than a "one-sized fits all" approach for learners of any age. In a seminal work on andragogy, the teaching of adult learners, Kabuga (1977) identified three characteristics that are important to think about while teaching to adults: *self-concept*, which requires that adults be able to identify their own educational needs; *experience*, which requires that techniques such as group discussions and supervision be used to reinforce concepts;

7 There is ample evidence that evidence that young children also lose substantive quantities of skills during school breaks (Slade et al. 2017 in Malawi, amongst others). While this is similar to adult learning losses, the primary constraint is the potential difficulty for adults to re-acquire these skills later, given challenges surrounding neuroplasticity.

and recognizing the *time perspective*, as adults want to put immediate use to what they learn and use that learning to solve problems.

Third, given the limits of brain plasticity, exercises and practical applications become more relevant for adult learners. This means having different aids to assist with decoding and automaticity, as well as group discussions to assist with comprehension and evaluation. Longer instruction and additional practice Projein decoding may be critical to improve reading performance (Abadzi 2016, Sabatini et al. 2011). Even the time intensive Kha Ri Gude program in South Africa may not offer sufficient instruction; program feedback suggests that even 240 hours over 6 months may not be enough (McKay 2015). Unfortunately, the dearth of research implies that we have little insight into how much time and practice is enough.

Finally, recent research posits that these processes are further compounded once learning new scripts, as adults exhibit patterns of dyslexia. For example, when neoliterates glance at a text, they often see a jumble of letters and may process only a few of their features. This phenomenon, called "neoliterate adult dyslexia" (NAD), suggests that individuals become dyslexic for new scripts at about the age of 19, and this ability decreases with age (Abadzi 2019).

3. What else affects adult literacy learning? Time, stressors, motivation and returns[8]

Unlike younger school-aged children, adults have competing demands on their time. These opportunity costs exhibit significant heterogeneity over time, economic activity and gender, and, as such, without immediate and concrete benefits—monetary or otherwise—these programs may not be seen as valuable relative to work, home production or leisure activities (Wagner, 2000; Abadzi, 2003).

A key question for andragogy is how to effectively motivate adult learners, whether intrinsically ("internally regulated") or extrinsically ("externally regulated").[9] While extrinsic motivation may be linked with adults' opportunity costs or uncertainty in returns, motivation is also related to how adults respond to difficult tasks. Existing research suggests that adult learners perform better when feedback is available and provided quickly; for example, Tricomi et al. (2006) found that brain-level responses were similar when either feedback or financial rewards were provided.

8 Other factors that may affect adult learning—but are not necessarily specific to adults—are adequate nutrition and sleep, a "chaotic" home environment, the learning environment, noise and temperature. A substantial literature on the impacts of auditory noise on adults has found that noise of low to moderate intensity may in fact evoke substantial impairments in cognitive performance (Hellbrück and Liebl, 2007; Szalma and Hancock, 2011).

9 "Intrinsic motivation is associated with curiosity, exploration, spontaneity, and interest … extrinsic motivation is associated with undertaken to attain an end state that is separate from the actual behavior … determined by some external contingency such as good marks or the avoidance of negative consequences." (Muller, 2004) Adults are motivated by some external factors, such as promotions, salaries, and pressure from authority figures. However, internal motivators that help adults solve problems in their life, such as increased job satisfaction, self-esteem, quality of life, tend to be more powerful motivators (Knowles, 2005).

Adult learners also face additional stressors that children and adolescents do not. While all learners must face work deadlines, examinations, and relationships with teachers and peers, adults must also balance family, work and educational pressures (Jones 2014). These stressors may diminish adults' capacity to learn; a number of psychology studies suggest that cognitive performance increases with mild stress, until a point where stress begins to interfere with cognitive performance (Jones 2014).[10]

Compounding the issue of the opportunity costs is the degree of uncertainty regarding the economic and social returns to adult learning.[11] While this uncertainty is the case for all learners, in light of higher opportunity costs and the shorter time horizon through which to observe these benefits, these returns may be more salient for adult learners. Proponents of adult education programs cite a number of different pathways through which adult education could improve welfare: by helping learners obtain higher-paying jobs or helping them adopt new technologies; improving mental health, as learning and engagement with written material can stave off cognitive decline (Hoare 2006); positive inter-generational spillovers, as children's health and learning outcomes are often correlated with improved adult education[12]; and social returns, as the cost of adult illiteracy to developing countries' has been estimated at over $5 billion annually (Cree et al., 2012).

4. Adult education programs: What we do and do not know

A. Do adult education programs improve learning?

What do we know about the impacts of adult learning programs on learning outcomes, self-esteem and economic welfare? Earlier studies on the impact of such programs often relied upon self-reported literacy measures, small sample sizes and non-random placement. Yet a number of more recent studies have attempted to address these issues by using experimental and non-experimental methods. The majority of recent empirical research finds that adult education classes have larger impacts on math as compared with reading skills; where there are impacts on reading, it is primarily on decoding as opposed to comprehension (Alamprese et al. 2011, Sabatini et al. 2011, Aker et al. 2012, Banerji et al. 2017, Abadzi et al. 2010, Aker et al. 2012, 2019, 2020). Many of these studies have

10 A key stressor for adults, which is often not considered, is adult learners' poor performance, which can be demotivating (Mizuno et al.). Educated adults struggling with a new script generally give up within a few minutes, unless they must absolutely get through a text (Abadzi 2019).

11 As a result, one approach used in many adult education programs has been to provide information to adults on the potential socio-economic benefits of the program. As Rogers (1999) points out, "vigorous efforts are made to exalt the value of literacy and the disadvantages of being 'illiterate'. Exaggerated (and in many cases clearly false) promises about the socio-economic benefits of 'being literate' are made to the participants—(leading) ... the participants to assume that they will benefit directly from learning literacy skills in a classroom setting. But in practice, the socio-economic benefits which arise from literacy do not spring from learning literacy skills, but from using literacy skills in real life to achieve real goals set by the participants (ODA 1994).

12 In the "Impact of non-formal adult education in the Asia-Pacific Region: a four-country study." By UNESCO Principal Regional Office. As adult education programs often include exposure to health information, potential immediate returns may include spillover effects into the health domain for the participant and household.

also found relatively small impacts in terms of magnitude; even if the impacts on decoding are statistically significant, few adults achieve the threshold of 1.5 words/second.

Adult literacy programs in Africa usually provide instruction in basic reading, writing and math skills in a classroom setting, usually in one's native language, in order to allow adults to decode in a language that they speak and understand. In some cases, although more rarely, these programs also transition to instruction in other languages, namely English, French and Portuguese (Rogers 1999). These classes typically last for 4–5 months, meeting five times per week for three hours per day over nine months, usually during a time of year that does not compete with major agricultural activities (Carron 1990, Okech et al. 2001, Aker et al. 2012). Thus, a typical adult education course would provide approximately 480 hours of instruction, a substantial time investment for busy adults. In terms of content, these classes primarily focus on *decoding*—namely, identifying letters, syllables and words, as well as numbers—with little focus on automaticity or reading comprehension, which are crucial for sustained learning (Abadzi 1992). In addition, many of these classes do not necessarily help literacy participants to "transfer the literacy skills they learn in the classroom … into use in their daily lives" (Rogers 1999, Lauglo 2000, Abadzi 1992).

There are several studies assessing the impact of different instructional approaches on adult learning, finding positive effects on decoding (Alamprese et al. 2011, Sabatini et al. 2011 and Royer et al. 2004). Alamprese et al. (2011) conducted a randomized control trial (RCT) of a US adult education program, testing the impact of a curriculum that focused specifically on improving learners' decoding and spelling, as compared with the typical curriculum. Overall, they found significant gains in decoding skills as compared with the control group, but no statistically significant effects on word recognition, spelling, fluency or comprehension, which are crucial for sustained learning. Similarly, Sabatini et al. (2011) investigated the effect of explicit phonics and guided reading instruction for adults with limited decoding skills in the US. They found statistically significant gains in basic reading skills for students who completed the programs, yet the magnitude of these gains was modest. Using a RCT in Burkina Faso, Royer et al. (2004) tested the impact of different learning approaches, including training in phonological awareness (PA), the rapid identification of reading material (RR) or both (PA + RR). While all three treatments increased reading skills relative to the normal adult education program, the treatments were the most effective in increasing adults' letter, syllable and word recognition, primarily in programs with longer cycles. Finally, in the US, Hock et al. (2011) conducted an RCT on the impact of different "metacognitive learning strategies" on adults' reading comprehension and skills in the US, and found no statistically significant effects. The authors explained these non-results by "insufficient instructional intensity (dosage)" (Hock et al. 2011).

Even if adult education programs are successful in improving skills in the short-term, if adults are not able to use these skills in daily life, they may not be sustained. With the growth of information technology throughout sub-Saharan Africa, Aker et al. (2012) tested the potential for using simple mobile phones as a pedagogical tool in adult education programs in Niger. Using an RCT, villages

were randomly assigned either to the standard adult education program or a program that taught adults how to use simple operations on a mobile phone (ABC). Overall, the authors found that learning how to use the mobile phone increased writing and math skills by 0.18–0.25 s.d., with stronger effects for math. These results persisted six months after the program, as well as two years later, mainly because the mobile phone allowed adults to continue practicing outside of class, as well as integrate their newly-acquired skills into their daily lives (Aker et al., 2012). However, since the authors did not use tests designed to measure reading automaticity, a direct comparison of the impact of the program on decoding versus comprehension skills was not possible. Nevertheless, the absolute gains in learning were small and primarily focused on simple decoding. In addition, since there was no pure control group, the authors were unable to assess the impacts of the adult education program alone.[13]

Increased flexibility through use of digital tools in terms of when and where adult learners practice literacy skills may help address the need for additional practice and the high opportunity costs. In recognition of the high drop-out in US literacy programs, as well as the need to practice skills outside of the classroom, Ksoll et al. (2018) assessed the impact of a mobile phone-based literacy curriculum on adults' reading and self-esteem scores for low-literate Spanish speakers in Los Angeles. Using a standard Spanish literacy curriculum (*Leamos!*), the authors worked to transfer the different modules of the in-class curriculum on a mobile-based platform of over 400 micro-modules (*Cell-Ed*). Using a simple mobile phone, the platform enabled adults to receive a call, a text and an interactive quiz. The increase in *Cell-Ed* participants' reading skills after four months was equivalent to the reading skills children acquire after two years of schooling. These results suggest that more flexible learning may address some of the constraints of existing adult education programs.

Given high rates of teacher absenteeism observed in adult education programs, digital technology also offers an opportunity to serve as a monitoring and pedagogical tool for teachers. Aker and Ksoll (2019) conducted an RCT in Niger, whereby villages were randomly assigned to either the standard adult education program or a control; within the adult education program, villages were randomly assigned to a mobile phone-based monitoring program or the standard monitoring program. Teachers and students in the mobile phone-based monitoring treatment received calls asking about their classes and teaching, while those in the standard monitoring program received periodic site visits. Overall, the authors found that adults in the standard adult education program improved their decoding skills significantly as compared to the pure control group, but less than 12 percent were able to complete any of the reading comprehension tests and less than 15 percent were able to reach the reading threshold of 1.5 words/second. The mobile phone monitoring component increased reading and math skills significantly, almost doubling the learning results, primarily through its motivational effects.

13 As students in all villages received a "participation incentive"—namely, a bag of grain each month for attending 80% of classes—the authors did not assess the impact of the intervention or attendance or drop-out.

Finally, in India, Deshpande et al. (2017) study the impact of a computer-based adult literacy and numeracy program (TARA Akshar Plus) on learning outcomes in India. Using a RCT comparing the computer-based program with a pure control, the authors find large and statistically significant effects of the program on reading and math scores, with larger effects approximately one year after the end of the program.

B. Do adult education programs improve other measures of well-being?

In contrast to the substantial evidence on the economic returns to primary and secondary education, there is little evidence on the economic and social returns to adult education programs. Beyond learning, adult education could potentially lead to higher immediate private returns via higher-paying jobs or improved technology adoption; improved mental health, as learning and engagement with written material can stave off cognitive decline (Hoare 2006); lead to **positive inter-generational** spillovers, as children's health and learning outcomes are often correlated with improved adult education; lead to **positive spillovers on other social sectors** (e.g., health, environment); and lead to **higher social returns via the improved impacts of a more educated population**.

Despite these potential channels of impact, most of the research in adult education has focused on the impacts on learning, rather than on other measures of well-being (Rogers 1999, Aker and Ksoll 2012). In the area of economic returns, two key exceptions are Blunch and Portner's study in Ghana (2011), which studied the impact of an adult education program on household welfare, and Aker and Ksoll's study in Niger (2020). In Ghana, the authors found that adult education led to a 5% increase in consumption, similar to the returns to primary education (Blunch and Portner 2011).[14] Yet the adult education model studied was more akin to a vocational training program as it provided a package of income-generating interventions, in addition to basic literacy and numeracy.[15] In Niger, Aker and Ksoll (2020) found that adults who had higher learning outcomes were more likely to save, had more durable assets and higher food security two years after the program, but did not have any measurable impacts upon income-generating activities, wages or income earned from agriculture.[16]

14 In a review that uses 61 nationally representative LSMS surveys from 25 low-income countries between 1985 and 2012, Peet et al. (2015) find an average return to schooling of 7.5%.

15 One of the main features of the Ghana program was income generation, which aimed at equipping participants with occupational skills. The entire program took about 21 months, with classes meeting 2–3 times per week for 2–3 hours each session. For comparison, the Venezulean "Mision Robinson" courses lasted only 7 weeks, and other standard adult education programs in West Africa last about 10 months.

16 For example, the technology adoption literature suggests that low education levels are correlated with low levels of agricultural adoption (e.g., Foster and Rosenzweig 2010, Rosenzweig 1995); as a result, improved education outcomes could potentially minimize some of the constraints associated with technological adoption. In addition, a key market failure for labor markets and agricultural markets is that of imperfect information, namely, individuals' ability to get access to and analyze information. Existing evidence in Niger suggests that traders share market information via mobile phones, and particularly text, which is cheaper (Aker 2008). Thus, improved learning outcomes could, in theory, allow farmers to access such market information in different ways.

Focusing on mental health improvements, Ksoll et al. (2018) found that those who participated in an adult education program in Los Angeles had higher self-esteem as compared with the control group, although a minimum threshold of learning needed to be achieved. Similarly, Banerji et al. (2017) found that adult education interventions in India improved women's empowerment, as measured by an index of 19 variables including women's decision-making ability, ability to carry out tasks independently, involvement in household decision-making, and beliefs about education.

In the area of inter-generational spillovers: in other words, more educated parents may invest more in their children's education, thereby improving their children's educational outcomes. While there are a number of studies showing the correlation between parents' and children's education, there are few that specifically assess the impact of adult education programs on these spillovers. One exception is Banerji et al. (2017), who found that women who participated in an adult education program in India were more involved in their children's education, thereby improving their children's math scores (Banerji et al. 2017).

5. How does this compare with current practice?

Overall, the results of research in lower-income countries, including in India, Latin America and sub-Saharan Africa, suggest that adult education programs can improve adult participants' reading and math skills, with stronger effects on math. In the area of reading, the impacts are modest, although strongest in the area of "decoding"—i.e., recognizing letters, syllables or words—rather than comprehension. Furthermore, when statistically significant gains are found, the effect sizes are small. While there is some evidence suggesting that these programs can improve consumption, asset accumulation, savings and self-esteem, the body of evidence is limited to particular contexts.

What explains these relatively modest impacts on learning? While adult education programs within sub-Saharan Africa can vary substantially both across and within countries, a number of characteristics of adult education programs can limit the learning gains.

First, many programs focus primarily on *decoding*, rather than automaticity and reading comprehension. While decoding is a natural pre-condition for achieving literacy, without pedagogical support in automaticity and comprehension, it can be difficult for adults to achieve a minimum threshold of learning, which in turn, limits adults' ability to practice their literacy skills in their daily life. Thus, in the absence of a specific curriculum teaching adults how to make this transition, adults may quickly forget the skills learned in class. If those skills were not fully mastered, as mentioned above, then any gains acquired during class can be easily lost (Royer et al. 2004).

Second, adult education programs in sub-Saharan Africa are often offered during specific periods of year, in an effort to minimize competing demands on adults' time during the agricultural season.[17] As a result, classes can be extremely intensive over a short time period; for example, some literacy programs require an investment of 60 class hours per month over a five or six-month period. The intensity, combined with strict curriculum schedules, often means that adult students may not be able to sufficiently practice, which is required due to limits on brain plasticity in adult brains (Thomas and Johnson 2008).

Third, while significant resources are spent on teacher training for adult education classes, such trainings often pay less attention on how to teach to adults. The principles of adult learning—including the idea of self-concept, experience and time perspective—are not always included in adult education classes. This could be due to practical and logistical reasons, such as adults' time constraints, the number of curricular modules that need to be covered or the scale of national adult literacy campaigns. In addition, many adult education programs are taught by community literacy teachers, who may be paid or volunteers. While these teachers are often highly motivated and may be more easily observed by the community, they also have competing demands on their time.

Finally, many adult education programs often face challenges in addressing adults' motivation to participate, as reflected in low levels of attendance and high drop-out. In almost all of the studies cited above, dropout was high (ranging from 17% in Niger to 58% in India) and attendance was sporadic, even among those who persisted in the program until the end. Adults have competing demands on their time, and, without immediate and concrete benefits—monetary or otherwise—these programs may not be seen as valuable relative to work, production or leisure (Wagner, 2000; Abadzi, 2003). While some adult education programs have attempted to address these issues by providing cash or in-kind compensation, the impacts of incentives has been mixed or rarely studied in low-income countries has not been widely studied (Brooks et al. 2008).

6. Where do we go from here?

Illiteracy remains an important challenge in many areas of the world, in particular sub-Saharan Africa and parts of Asia. While there is significant research on the neuroscience of adult learning, specifically in higher-income countries, it is not clear that this research is being incorporated into existing adult education programs, which may partially explain their limited sustained impacts. In addition, despite the prevalence of adult education programs worldwide, there is little research on adult education as compared with other educational investments. Research that does exist primarily focuses on learning in the short-term, rather than on the private or social returns. As a result, this makes it difficult to weigh the costs and benefits of such programs.

17 In addition, many adult education programs in West Africa take place during the "hot" period—which is also the period when opportunity costs are lower—where temperatures can reach more than 45 degrees Celsius. These conditions can further slow down the learning process (Shield and Dockrell 2008).

Nevertheless, the existing cognitive and empirical research on adult learning and education offers several insights into how such programs should be designed and evaluated. First, adult education programs need to be designed to address cognitive and environmental issues: 1) the specific neurocognitive needs of adults; 2) the intrinsic and extrinsic motivations of adult learners, which can be supported by external payments, information or the (easier) transition of such skills into daily life; and 3) the opportunity costs of adults' time, which may or may not be related to motivation. While each program must consider these areas in their context, recognizing that the needs of adult learners and the opportunity costs they face will differ from one area to another, the principles of andragogy may potentially be more applicable across contexts.

Existing research suggests that certain key aspects of curriculum design must be met for adult learners to learn in a sustainable way. Any adult education curriculum should emphasize fundamentals, the latter of which are necessary in order to consolidate literacy skills. In addition, practice and repetition are necessary for an adult brain to learn to read, and technology can play an important role in facilitating additional practice, especially outside of the classroom. And finally, programs must include enough instruction, with a particular focus on practice. Adults need more practice than children—this takes time, especially for opaque languages. This could also require the use of *perceptually enhanced texts*, with large size and spacing and with many pages for practice (Abadzi 2019). At the same time, this need for sufficient practice must be balanced with the opportunity costs for adult learners, thus requiring flexible schedules. This is the concept of a "fault tolerant" design—designing the program so that it allows for the flexibility that adult learners need (in terms of time and practice) while achieving the learning objectives (Mullainathan and Shafir 2013). This is where technology could play an important and strategic role, allowing adults to learn when and where it fits into their busy schedules.

In terms of motivation, the recommendations are a bit more nuanced, and there is little research or practice to support this. While concrete and accurate returns to adult education programs should be clearly communicated to potential learners, such returns have not been clearly identified or measured. In the absence of this information, adult education programs could potentially ensure that adult education programs provide skills that are relevant to daily life and allow adult students to quickly observe the impacts of their investments and hence remain motivated. This could either be linking the curriculum to daily activities—i.e., linking numeracy to savings group accounting, or literacy to the use of text messages.

Sufficient instruction time can come into direct conflict with the opportunity costs of adult's time (and, in turn, affect their motivation). Adult learners face significant opportunity costs to participating in such programs, and these can differ by context and sub-groups of learners (e.g., gender and occupation). If key opportunity costs are identified, steps can be taken to address them, either using monetary or non-monetary mechanisms. For example, classes can be planned for less busy times of the day or the year; in a rural agricultural context, this could be offered during the "off" season or in the evenings, whereas in an urban setting, classes may need to be offered at times that

accommodate work schedules. In contexts where adult learners are also caring for young children, offering childcare may address a critical constraint, thereby allowing students to concentrate more fully on the class.[18] Finally, financial incentives (e.g., conditional or unconditional cash transfers or scholarships) might be necessary, although the research on this is limited.

While most of the existing empirical research supports some of the recommendations above, more research is needed on adult education programs in general. For example, strategies for effectively motivating adults to participate in classes are poorly understood, including the role of financial incentives. In the area of curriculum design, there is little research on the efficacy of different metacognitive strategies for adults, a key step in consolidating literacy skills.[19] This is also true for the amount of instruction required, or policies that address adults' intrinsic and extrinsic motivation to invest in adult learning. And finally, it is crucial for those invested in adult education to understand the role of neurocognitive barriers to literacy acquisition.

18 For example, given interest in pre-school programs, if investment in such programs is already happening, one possibility is to provide adult education programs as a complement to preschool programs.

19 In general, little is known about the prevalence of learning disabilities among adult and child learners in low-income countries. If dyslexia is prevalent among the population of adult learners in a particular context, then curricula should be adapted to the needs of those learners (Abadzi 2019).

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