

STATE-OF-THE-ART ARTICLE

A critical review of research relating to the learning, use and effects of additional and multiple languages in later life

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Abstract

While there is a growing body of research on second language acquisition (SLA) in children, adolescents, young and more mature adults, much remains to be explored about how adults in later life learn a new language and how good additional language learning is for THEM. Our goal in this article is to survey and evaluate what is known about the linguistic, socio-affective, neurobiological and cognitive underpinnings of the second language (L2) learning process in older individuals, the extent to which L2 acquisition may be seen as contributing to healthy and active ageing, and how these phenomena are to be approached scientifically, methodologically and pedagogically. Our view is that a developmental enterprise as complex as L2 learning in senior adulthood and its effects in later life cannot be explained by a single theory or set of principles. Furthermore, we take it that L2 acquisition in the third age needs to be regarded not just as a goal in itself but as a means of promoting social interaction and integration, and that it is partly through the stimulation of social well-being that its cognitive effects may potentially be observed.

1. Introduction

The study of L2 learning in late adulthood merits attention for a number of reasons. Societies are ageing; recent United Nations projections indicate that in about a decade the number of people in the worldwide population aged 60 or over will grow by 56% (United Nations, 2015), which makes older adults the fastest-growing segment of the world's population. At the same time, international migration will continue to impact on the demographics of numerous countries. Young and even mature people are emigrating from their homelands for economic reasons, often leaving behind elderly parents. When settled in the new country, they start families; children are born who do not always speak the native language of their parents. Consequently, grandparents may find themselves in the undesirable situation of not being able to communicate with their grandchildren (e.g., Pot, Keijzer, & de Bot, 2018a). International migration also includes refugees and immigrants who are either ageing in their host country or who arrive as older adults. These groups feel immense societal pressure to acculturate and also experience the draw of the economic advantages deriving from mastery of the host country's language. Impediments evident in this connection include lack of time on the part of migrants to commit to language learning, diversity of learner backgrounds, few opportunities to communicate in the target language, the fact that migrants' networks may be L1-based, and the phenomenon of social isolation (see Gardner, 2002; Treas & Mazumdar, 2002; Warnes & Williams, 2006; Cox, 2019). Finally, the growth of mobility across the world has created the desideratum for travellers and migrants to communicate comfortably in languages not well known to them – for which the present-day third-age generation is generally ill-equipped (Gabrys-Barker, 2018). Cox (2019) argues that increased life expectancy and international migration do not operate in isolation: ageing and

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migration intersect both in the case of earlier arrivals ageing in their adopted country and in the case of new arrivals who migrate as older adults.

In many countries, age 65 marks the end of professional activity. For many, the onset of retirement constitutes the beginning of an era of ‘personal achievement and fulfillment’ (Laslett, 1987, p. 134). Such individuals may devote their retirement to travelling, taking up new hobbies and learning new skills. Thus, Ware et al. (2017) outline how adult L2 learning may become a pleasurable lifestyle choice. This has given rise to the perceived need to develop various models of lifelong learning and education, facilitated by the fast-growing development of technology and the availability of relevant resources (see Gabrys-Barker, 2018). There has been a growing focus on mobility and on learner autonomy in education, as well as on learning for pleasure and health, prompting the imperative for a careful examination of the various dimensions and consequences of this perceived need.

Finally, research into all categories of older adult multilinguals is lacking in SLA and applied linguistics (Cox, 2019; Singleton & Pfenninger, 2019), despite its societal and scientific importance. The learning of additional languages in the third age has only recently begun to be researched with any intensity. Ortega comments: ‘if ... SLA researchers do not study certain populations, we do not serve them, either’ (2005, p. 434). There are signs, though, that age researchers are increasingly looking to investigate third-age learners. Methodologies vary greatly, including, for example: case studies (e.g., Schulz & Elliott, 2000; Swain & Lapkin, 2011); qualitative interviews and surveys (e.g., Bernal Castañeda, 2017); and laboratory studies that take either an ‘extreme-groups’ design comparing young adults to older adults (Lenet, Sanz, Lado, Howard, & Howard, 2011) or focus on older adult learning only (Mackey & Sachs, 2012; Ramírez Gómez, 2016; Cox, 2017).

This article begins with a brief general summary of our state of knowledge regarding the acquisition of additional languages in late adulthood, with a focus on the question of what older learners bring to the learning of additional languages. Investigating the complexity of the age factor in SLA research is an inter- and transdisciplinary endeavour, bringing together, *inter alia*, the fields of SLA, multilingualism, psycholinguistics, neurolinguistics and cognitive psychology. We subsequently discuss the question of the various benefits of L2 learning in the third age. Some studies suggest that L2 learning may contribute to active and healthy ageing, being a cognitively challenging activity that seems in specific circumstances to promote neural plasticity and to foster social interaction and individual mobility (Antoniou, Gunasekera, & Wong, 2013). Other studies, by contrast, do not report cognitive gains as a function of L2 learning (e.g. Berggren, Nilsson, Brehmer, Schmiedek, & Lövdén, 2018). The final part of the review addresses the teaching of additional languages to third-age learners – what educational planners and teachers need to be attentive to and the areas in which they can expect late language learners to excel.

2. Constructing the ‘third age’ and third-age identities

What does the label ‘third age’ precisely include? When does the participant sample of a study qualify as consisting of ‘third-age’ or senior learners, and how flexible is this label? Age is strongly related to a number – that is, the number of years that have passed since one’s birth. Furthermore, in many societies, retirement is still promoted as a shift from full-time employment to full-time leisure around age 62 or 65 (Degnen, 2007; Moen, 2001). Some scholars try to attribute a certain number of years to the third age, while others state that the third age begins and ends at given ages. These efforts constitute ‘age-grading’ (Oxford, 2018). Lawrence-Lightfoot (2009) identified ‘the third chapter’ (roughly equivalent to the third age) as lasting from age 50 to 75; whereas for Smith (2000) the third age extends from 70 to 84. In Goral (2019) the definition of ‘older’ refers to adults who are 60 years and older. The eighth and final stage of Erikson’s (1982) model of psychosocial development, which is characterised by dichotomies of intimacy versus isolation, generativity versus stagnation and integrity versus despair, identified as starting around 65, might purportedly involve a crisis of identity or despair and might include the third age. Since theorists typically view the third age as a time before any serious disability arises for a given person (Oxford, 2018), it has been hypothesized third age (as a state) could be

‘prolonged’ through language learning as an ‘anti-ageing activity’ (Ryan & Dörnyei, 2013, p. 93; see our discussion below).

As Oxford (2018) has noted, reliance on chronological or calendar age is problematic in many respects. Although age is used to describe individuals, its nature and influence do not originate solely within the individual; at any point in life, the import of age derives to a large extent from how life is socially organised (Gullette, 2003). In other words, although everyone experiences ageing in his/her unique way, people are always ‘aged by culture’ in the sense that cultural ageing discourses delimit experiences (Isopahkala-Bouret, 2015). Treating age as a numerical attribute of the person ignores considerations concerning the social utilization of age as a categorisation and identification device (Rughiniş & Humă, 2015). Finally, the length of the third age is difficult to ‘set in stone’, as social, medical and scientific advances make possible an ever-increasing number of third-age years (Oxford, 2018).

The cultural and social contexts of ageing have changed greatly over the last two decades and ageing experiences have become more differentiated (see e.g. Biggs, 2005). The range of descriptions of ageing has expanded to the extent that ‘old age’ as we knew it is now joined by ‘third age’ and its associated array of new possibilities. There have been few attempts, however, precisely to understand the denomination ‘third age’ (and indeed ‘fourth age’), let alone to theorise around them. In Laslett’s seminal book on the third age, *A Fresh Map of Life*, he defined third-agers as ‘active seniors with free time’, depicting the fourth age as a period of decline and decrepitude that particularly affected those who lived beyond their mid-eighties (Laslett, 1989, p. 41). The third age is typically viewed as a time BEFORE any serious disability arises for a given person, a period of subjective well-being, while the ‘fourth age’ implies the presence of disability (Carr & Komp, 2011). Sometimes referred to as the ‘young-old age’ or even ‘the golden age of adulthood’ (Barnes, 2011, p. 1), part of the definition of the third age is thus its exclusion of ‘old age’ and ‘agedness’ (Gilleard & Higgs, 2010). Oxford (2018) uses the term ‘third-agers’ to refer to ‘healthy, motivated individuals no longer working full-time’, as compared to the fourth age, which is termed ‘old-old’ age or ‘old age’. Gilleard and Higgs (2010) argue that the fourth age is not about non-participation in the cultural field of the third age. As a space ‘where choice, autonomy, self-expression, and pleasure collapse into a silent negativity’ (p. 126), the fourth age does not necessarily represent a particular age cohort or distinct phase of life; rather, it is defined as a metaphorical ‘black hole of ageing’ (p. 125) or the ‘othering of old age’ (p. 126).

The identities offered to older adults are becoming more diverse. Isopahkala-Bouret (2015) suggests that people who are now in their 60s have reached middle age in ways that are quite unlike those of their parents or grandparents. For present-day 60-year-olds ageing is no longer defined only by standardized life-course trajectories. Rather, much of the cultural fabric that makes the so-called ‘third age’ can be traced to the identity politics of the 1960s and its emphasis upon choice, autonomy, self-expression and pleasure (Gilleard & Higgs, 2002, 2009). As fixed identities cease to be ascribed to age, a self-conscious compromise is required between intention, external pressures, and one’s own interior world (Biggs, 2005, p. 118). Older adults may increasingly experience multiple and manifold pressures on ageing identities that were previously experienced as stable and predictable (Biggs, 2005).

Thus, there has recently been a ‘cultural turn’ in gerontology (Biggs, 2005, p. 119); adult ageing is perceived as becoming increasingly homogeneous in terms of age boundaries. How far are adults the same regardless of age and how far does later life have its own distinctive qualities? Originally, ‘distinctivist’ trends could be identified in work (e.g. Cole, 1992) which argued for discernible differences between later life and other parts of adult life. The argument that life-course categories are becoming increasingly indistinct was initiated by Featherstone and Hepworth (1983, 1989, 1991, 1995) and has been followed through in the cultural sociology of Gilleard and Higgs (2002, 2009, 2010, 2013). Moen (2001), likewise, calls for the consideration of alternative, more flexible life paths. According to Biggs (2005) the possibility of virtual identities has multiplied the options open to older people no longer bound by social and biological reference points. Biggs speculates that the suggestion that adult ageing is becoming increasingly homogeneous means that soon there may be little reason to study late life separately from other parts of the life-course. If, however, later life is seen as subject

to its own specific priorities, then the ability to interchange older with younger age groups becomes questionable.

In sum, chronological age does not determine the positioning of L2 learners in later life: age is part of a complex web of social distinctions such as gender, socio-economic background and psychological and individual factors that intersect in the construction of a learner's relative status and opportunities.

3. What older learners bring to the learning of additional languages

Growing evidence from research in education, psycholinguistics, cognitive science and neurolinguistics challenges the view that the age factor as the non-plus-ultra predictor of L2 learning outcome, arguing, for example, that even young adult L2 beginners can reach native-like L2 proficiency (see e.g. Moyer, 2004; Birdsong, 2006; Muñoz & Singleton, 2011; Kinsella & Singleton, 2014). However, there is broad acceptance of the notion of multifactorial differences between child and adult L2 acquisition, and likewise there are also claimed to be reasons why younger and older adults should be treated differently in the SLA context. First, there are structural and functional changes in the ageing brain between younger and older adulthood, and there is research which suggests that such changes influence cognitive functioning and the brain's ability to learn. Second, there is a pronounced degree of variability among older adults, relating to variation in lifestyle factors and measure of involvement in cognitively stimulating activities (e.g. engagement with additional languages) in later life, and this variation has been shown to modulate cognitive performance. Third, third-agers' attitudes towards L2 acquisition can be expected to vary considerably, not only between younger and older adults but also actually *AMONG* older adults. Reasons for this may stem from differences in employment status, amount of free time available, changes that have occurred in the political situation, personal interests, personality traits or even social stigma.

3.1 (Neuro)cognitive aspects of L2 acquisition in the third age

Age-related declines – as measured e.g. in scores on neuropsychological tests – are widely believed to reveal that human cognitive capacities decline across the lifespan. This kind of account often refers to

- a slowing of processing speed (Salthouse, 2000, 2011),
- reduced working memory capacity (e.g. Borella, Carretti, & De Beni, 2008),
- reduced learning and recalling of new information (Lindenberger, 2014),
- decrease in attention (e.g. Cullum et al., 2000; Park & Reuter-Lorenz, 2009),
- increase in reaction times, i.e. slower lexical access and recognition (Goral, Spiro, Albert, Obler, & Connor, 2007; Deary, Johnson, & Starr, 2010),
- poorer encoding of contextual information in memory (Naveh-Benjamin & Old, 2008) and difficulties remembering people's names (Cohen & Faulkner, 1986; Lovelace & Twohig, 1990),
- deficits in inhibitory control (e.g. Verhaeghen & Cerella, 2008), and
- changes in speech production and perception (e.g. Wingfield & Grossman, 2006; Burke & Shafto, 2008).

Such age-related cognitive decline has been reported to be preceded by structural changes, such as a loss of functional brain connectivity and a decline of white matter integrity (Sowell et al., 2003; Salat et al., 2004; Raz, 2005; Damoiseaux et al., 2008; Fjell et al., 2009). The human brain undergoes linear and non-linear maturational trajectories from childhood to older adulthood characterised by prominent grey and white matter changes (Gogtay et al., 2004; Ziegler et al., 2012). Numerous studies have demonstrated a pre-adolescence increase of grey matter volume followed by a decrease thereafter (Giedd et al., 2006). These changes are accompanied by changes in cellular plasticity such as a vast production of axons and synapses before puberty followed by pruning in later adolescence (Andersen, Thompson, Rutstein, Hostetter, & Teicher, 2000). What is commonly found in older

participants is grey and white matter degeneration in the prefrontal cortex (Raz et al., 2005; Fjell et al., 2009), medial and lateral temporal lobe and hippocampus (Fjell et al., 2009), parietal lobe (Resnick, Pham, Kraut, Zonderman, & Davatzikos, 2003) as well as basal ganglia (Ziegler et al., 2012; Jäncke, Mérillat, Liem, & Hänggi, 2015). It has to be emphasised, however, that although a causal link between decreases in white matter integrity and cortical degeneration is assumed, there is scarce knowledge on the relationship between these changes across the adult human lifespan. What is more, the causal direction of the relationship between changes in white matter and cortical structure is not clear (see e.g. Storsve, Fjell, Yendiki, & Walhovd, 2016).

Additionally, the involvement of auditory functions in SLA and the frequency of age-related hearing loss (presbycusis) in older adults (see Roth, Hanebuth, & Probst, 2011) may occasion problems for some older adults wanting to learn an additional language. Green (2018) suggests that in addition to affecting the perception and production of novel speech sounds, age-related declines are likely to exaggerate individual differences across a wide range of the cognitive control and memorial skills required in learning and using an L2 (also Goral, 2019); he also points to the absence of third-age studies relating individual variation in the neuroanatomy of the brain to language learning. The question of cognition in SLA and senescence is of importance inasmuch as language learning is a process that necessitates memorization, inhibition of the first language (L1), sustained attention in classroom settings, rule learning and application, pattern recognition, and metacognition. It is therefore not surprising that older L2 learners experience different degrees of ‘struggle’.

There are also accounts of how the brain COMPENSATES for the above-mentioned deficits. The neurocognitive ageing literature suggests that the brain preserves large parts of its dendritic and synaptic plasticity even at an advanced age and remains receptive towards new languages (e.g., Peltzer-Karpf, 2003; Scholz, Klein, Behrens, & Johansen-Berg, 2009; Schlegel, Rudelson, & Tse, 2012; Lövdén, Wenger, Mårtensson, Lindenberger, & Bäckman, 2013; Raz & Lindenberger, 2013). The Scaffolding Theory of Ageing and Cognition (Park & Reuter-Lorenz, 2009) suggests that there may be compensatory mechanisms that allow for a higher level of cognitive functioning despite structural decline. The theory points to processes such as frontal recruitment during difficult tasks, dedifferentiation, neurogenesis, and lateralization of functioning (Park & Reuter-Lorenz, 2009).

Brehmer, Kalpouzos, Wenger, and Lövdén (2014) review findings about emerging training-related brain changes, especially in the older brain, after strategy-based and process-based cognitive training as well as physical training. The authors show that such training may lead to plasticity changes at different levels: on the behavioural level, the level of functional brain activation and the level of structural brain changes. Brehmer et al. (2014) show that training leads to increases as well as decreases of brain activation. Whereas the decrease in brain activation along with an improvement of the function indicates increased efficiency, increases in brain activation may indicate the recruitment of additional brain regions and mechanisms that are required by the executed function. An important issue relates to the special relationship between functional and structural changes. While it seems necessary for functional brain activity to change preceding a possible structural change in the brain, not every training-related increase or decrease of functional activation necessarily results in structural brain changes. The authors highlight in this connection factors like training length and intensity, task difficulty, type of training, and baseline performance of individual subjects.

Discussing neuroplasticity in relation to L2 learning, Li, Legault, and Litcofsky (2014) review evidence regarding how structural neuroplasticity in the brain is influenced by bilingual experience. The evidence they present portrays a picture that is consistent with structural neuroplasticity effects observed for other domains: L2 experience-induced brain changes, including increased grey matter density and white matter integrity, can be found in children, young adults, and the elderly; can occur rapidly with short-term language learning or training; and are sensitive to age of acquisition, proficiency or performance, language-specific characteristics, and individual differences (see our discussion of the Bilingual Advantage (BA) in Section 3.2).

In fact, language is one of the best-preserved cognitive abilities in older age (Wingfield & Grossman, 2006) – although different aspects of language are susceptible to ageing. Wartenburger

et al.'s (2003) fMRI study suggested that the neural representation of grammatical processing was dependent on the age of acquisition (AoA), while neural activation during semantic judgment varied solely as a function of proficiency level. This finding was supported by Perani et al. (1998), whose study revealed decreasing differences in fMRI activations between L1 and L2 learners with increasing proficiency level during semantic processing, independent of age of onset of acquisition. This evidence suggests that a high proficiency level in foreign language (FL) semantics is achievable, even when individuals start learning a language in adulthood (see also Abutalebi, 2008). From a behavioural perspective, performance on a common lexical access test, the Controlled Oral Word Association Test (COWAT; Strauss, Sherman, & Spreen, 2006) 'FAS' subtest, seems to improve with education and experience; studies indicate that older adults can outperform younger adults on this task (e.g., Czaja, Sharit, Ownby, Roth, & Nair, 2001). Similarly, although older speakers tend to respond more slowly in lexical decision tasks, their accuracy on less frequent words is substantially higher than that of young speakers (Ramscar, Dye, & McCauley, 2013). Cognitive functions that increase with age have also been found in an international project on 'Mehrsprachigkeit und Lebensalter' ('Multilingualism and age', see Berthele & Kaiser, 2014). The main interest of this project lies in the investigation of selected linguistic skills with regard to the changes to which they are subjected in the course of life. In six subprojects, some of which are more psycholinguistically oriented, some more sociolinguistically oriented, specific aspects of FL learning and use were examined very closely at various stages of life. Analysing the effects of first exposure to an unknown language at different ages (152 participants between the ages of 10 to 86 years), Ristin-Kaufmann and Gullberg (2014) found that older participants are equally good – or even better – than younger participants when they derived new phonotactic knowledge from auditory L2 input: 'There is no evidence for a declining capacity to learn and generalise L2 phonotactics across the age span' (p. 14). Berthele and Vanhove (2014) found a similar advantage for older learners with respect to the acquisition of new (written) words. Older adults tend to have larger lexical repertoires and richer semantic knowledge than younger adults (Goral, 2019). Finally, Schwab et al. (2016) demonstrate that older participants (aged >65) engage in similar statistical learning and perform similarly to younger participants (age range 19–24) following a training period in which an artificial language was introduced.

On the other hand, findings indicate a wide variance in L2 acquisition attainment in older adults based on inter-individual differences such as cognitive functioning and auditory acuity (see e.g. Giroud, Lemke, Reich, Matthes, & Meyer, 2016; Giroud et al., 2018). Attention and cognitive control capacities have been shown to distinguish individuals on the basis, for instance, of previous L2 experience or social class (Cullum et al., 2000; Bialystok & Poarch, 2014), which raises the question: what do age-related declines in scores on neuropsychological tests really reveal? The evidence relative to reduced processing speed with increasing age etc. does not necessarily reflect AGEING or DECLINE but may simply reflect the predictable outcome of the CUMULATIVE EXPERIENCE OF LEARNING, i.e. INCREASED KNOWLEDGE. An accumulating body of evidence – notably Ramscar, Yarlett, Dye, Denny, and Thorpe (2010), Ramscar, Dye, and Klein (2013), Ramscar, Dye, and McCauley (2013), Ramscar, Hendrix, Shaoul, Milin, and Baayen (2014), Blanco et al. (2016) and Ramscar, Sun, Hendri, and Baayen (2017) – suggests that there may be no neurobiological evidence for any declines in the processing capacities of healthy older adults, 'except ... where there is evidence of pathology' (Ramscar et al., 2014, p. 34). Ramscar et al. (2014, 2017), for instance, were able to show in computational simulations that the patterns of response change in lexical decision tasks, which are typically taken as evidence for (and measures of) cognitive decline, arise out of basic principles of learning and emerge naturally in learning models as individuals acquire more knowledge: experience inevitably increases the overall range of knowledge any individual possesses, increasing the amount of information in (and complexity of) his or her cognitive systems. Thus, processing all this extra information in combination with the increased vocabulary search inevitably has a cost. Difficulty with lexical access and recognition Ramscar et al. (2014) explain in terms of growth of information in the lexicon with increasing experience: information processing may simply get harder if the information load in people's cognitive systems increases.

This raises the question as to whether learning can account for age-related memory differences. In Ramskar et al.'s (2017) computer simulations, performance declined even when learning capacities were constant, simply because cumulative linguistic experience makes meaningless word-pairings ever harder to learn (Ramskar et al., 2017).

Baayen, Tomaschek, Gahl, and Ramskar (2017) and Ramskar et al. (2014) also point to the impact of e.g. the effect of changing name distributions across time in an ever-expanding vocabulary: the results of their simulations suggest that names present a unique information-processing problem, and that this problem will be magnified by individual exposure to the distribution of names over time – which in turn is further complicated as the social network declines with age. Given the very real distress name recall causes individuals in later life, the unchecked rise in the information load of personal names should be a cause of social concern; and also, given the objective scale of these changes, it seems that to confound name recall problems with cognitive decline is akin to imputing to older adults personal responsibility for a social problem.

Along similar lines, while the poorer encoding of contextual information in memory is usually taken to indicate that the processes that 'bind' contextual information in memory decline with age, learning theory predicts that experience will increasingly make people insensitive to a great deal of background context, simply because ignoring uninformative cues is an integral part of learning (Kruschke, 2005). In Ramskar et al.'s (2014) words: 'If a common environmental change like retirement was to systematically reduce the variety of contexts people encounter in their lives, learning theory predicts that the amount of contextual information they learn will drop further, as the background rates of cues in remaining contexts rise. [...] [R]etirement is likely to decrease contextual variety at exactly the time when the organization of older adults' memories needs it most.' (p. 34). This is problematic inasmuch as discriminative learning by its very nature reduces sensitivity to everyday context (Kruschke, 1996); i.e. retirement is likely to make memories more confusable for individuals, irrespective of any 'cognitive decline'. Retirement also entails that social interactions formerly part of the pattern with work colleagues will be reduced, potentially leading to isolation and increasing the likelihood of depression (Teo et al., 2015).

In sum, older adults' changing performance on many neuropsychological and psychometric tests might simply reflect experience-related performance differences such as memory search demands, which escalate as experience grows. It needs to be borne in mind, however, that the team around Ramskar did not compare their behavioural simulations with models of cognitive decline. Furthermore, while their models explain that the influence of increased experience must not be underestimated, they do not EXCLUDE cognitive decline.

Finally, socio-affective variables have been hypothesised to serve as mitigating factors. For example, the efficiency of processes that induce the meaning of a new word associated with a novel word form reflects the coupling of the language sensitive regions in the brain with evolutionarily older regions involved in reward and motivation (Green, 2018). Prior differences in the connectivity of these regions are predictive of the ease with which young adults learn the meanings of novel words from sentences in their L1 (Ripollés et al., 2014). Green (2018) comments on such findings relative to third-age L2 learning: 'in the older learner reduced connectivity will affect the motivation to learn such that those with reduced connectivity are less motivated to learn an L2 in the first place or to put the time in to learn it' (see also data reported in Bellander et al., 2016, p. 38).

Along similar lines, Schwartz et al. (2016; Schwartz, Zhang, Michael, Eton, & Rapkin, 2018) suggest that so-called 'reserve-building activities' – intellectual, cultural, hobby, physical, and spiritual pursuits – are associated with improved social support, which in turn is associated with reduced neuroticism in individuals, better physical and mental health and neurocognitive function, as well as reduced tendencies to focus on negative interaction with the world. It is possible, for example, that engaging in reserve-building activities helps people to create and maintain relationships with others and buffer them from the negative impact of attending to their medical care.

Green (2018) cautions, however, that evidence of widespread plasticity in the older brain in response to challenge suggests that we should be wary of presuming that prior differences in

connectivity indicate hard constraints on a person's ability to learn a new language: 'Rather, isn't it possible that pleasure in being able to converse in a new language alters such connectivity?' (p. 38).

3.2 *The BA in adult L2 learning*

The suggestion is of a specific enhancement in bilinguals of domain-general executive control abilities – often referred to as working memory capacity – in adults such as monitoring (the ability to update information in working memory), shifting (the ability to switch between tasks), and/or inhibition (the ability to suppress dominant responses) (e.g. Antoniou et al., 2013, 2015; Bialystok et al., 2014). There is posited to be a prolongation of more efficient language learning, as compared to monolinguals, in terms of:

- the capacity to attain better general language proficiency (e.g. Cenoz & Valencia, 1994; Muñoz, 2000; Sanz, 2000; Abu-Rabia & Sanitsky, 2010; Bartolotti & Marian, 2012),
- more developed literacy skills (e.g. August & Hakuta, 1997; Bialystok, 2007),
- greater metalinguistic awareness (e.g. Jessner, 2008; Dillon, 2009),
- better use of learning strategies (e.g. Kemp, 2007),
- the availability of a broader linguistic repertoire (e.g. DeAngelis, 2007; Cenoz, 2013),
- better management of cross-linguistic interference (e.g. Bartolotti & Marian, 2012),
- superior pragmatic skill development (e.g. Safont Jorda, 2003), and
- superior vocabulary learning and processing in an additional languages (e.g. Keshavarz & Astaneh, 2004; Kaushanskaya & Marian, 2009; Bartolotti, Marian, Schroeder, & Shook, 2011; Kaushanskaya, 2012; Kaushanskaya & Rehtzigel, 2012; Zare & Mobarakeh, 2013; Wang & Saffran, 2014; Antoniou, Liang, Ettliger, & Wong, 2015).

It has also been suggested that bilingualism from early in life is associated with delaying the incidence of dementia (Wang, Karp, Winblad, & Fratiglioni, 2002; Alladi et al., 2013; Woumans et al., 2015; Vega-Mendoza, Alladi, and Bak 2019). In this context it has been pointed out that the use of multiple languages builds the cognitive reserve of older individuals, which allows them to function at the same level as monolinguals at a much lower degenerative level (e.g. Luo, Craik, Moreno, & Bialystok, 2013; see Bialystok et al., 2014; Li et al., 2017). Cognitive reserve refers to the brain's resilience in combating neuropathological damage, resulting from experience-based neural changes associated with a physically and mentally stimulating lifestyle (Stern, 2002, 2012; Whalley, Deary, Appleton, & Starr, 2004). One common, although somewhat artificial, differential classification of reserve is 'brain reserve' versus 'cognitive reserve'. While the latter describes the brain as attempting to 'cope with brain damage by using pre-existing cognitive processing approaches or by enlisting compensatory approaches' (Stern, 2012, p. 2), the former refers to the resilience of already established networks – the brain being able to tolerate more pathology before reaching a critical threshold for clinical symptoms to appear. Early bilingualism has often been linked to the mitigation of brain shrinkage by contributing to the preservation of a 'brain reserve capacity', the ability of the brain to continue to support functioning despite the accumulation of various kinds of lesion (Valenzuela, 2008; Kadyamusuma, Higby, & Obler, 2018). It is suggested that individuals with higher brain reserve can continue to live their lives normally even in the presence of declining neural structure such as the atrophy associated with ageing. Bilingual older adults are reported to have grey matter volume in the parietal lobe which mirrors that of young adults (Abutalebi et al., 2015) and to have better white matter tracts than their age-peers in the frontal lobe and the corpus callosum (Luk, Bialystok, Craik, & Grady, 2011; Olsen et al., 2015). Additionally, whereas with increasing age, monolinguals show decreases in the cortical thickness of the temporal pole and the prefrontal cortex, no such changes with age seems to be found in multilinguals (Abutalebi et al., 2014, 2015). Structural plasticity associated with cumulative bilingual experience has been posited to help maintain brain integrity during ageing, based on preserved grey matter volume

and white matter density in elderly bilinguals' frontoparietal and frontostriatal networks for executive control (Luk et al., 2011; Del Maschio et al., 2018).

It has been hypothesised that learning a new language qualifies as a cognitively stimulating activity and may be a fruitful asset in maintaining cognitive functioning. Many studies seem to illustrate this phenomenon: Zielińska (2015), for instance, reports on the case of an 85-year-old retired scientist who spent all her professional life as a researcher in chemistry and later in life became an extremely successful L2 learner owing apparently to cognitive reserve activation late in life.

However, a substantial body of counter-evidence has emerged recently, in part because of the multifaceted profiles of the bilinguals in the studies in question, but also owing to certain methodological inconsistencies and discrepancies (Duñabeitia & Carreiras, 2015; Paap, Johnson, & Sawi, 2015; de Bot, 2017; Samuel, Roehr-Brackin, Pak, & Kim, 2018). Paap et al. (2015), for instance, suggest that if BAs exist they are restricted to specific aspects of bilingual experience that enhance only specific components of executive function. Along similar lines, in one of the only studies on differences in syntactic processing between monolinguals and bilinguals, Grey, Sanz, Morgan-Short, and Ullman (2017) examined behavioural and neural correlates of learning an additional (artificial) language in early Mandarin–English bilinguals, compared to English monolinguals. While bilinguals and monolinguals showed distinct event-related potential (ERP) patterns, they did not differ on behavioural measures. Furthermore, there is also a large difference (a) between the results of verbal and non-verbal tasks and (b) between the measurement of executive function with non-verbal tests and REAL communication.

The BA also depends on older adult multilingual profiles (Cox, 2019). For instance, it has been suggested that the BA sometimes reported in non-linguistic domains is a finding circumscribed by both very specific and very unclear situations, and that it does not extend IN GENERAL to lifelong bilingual third-agers or to neo-bilingual third-agers (see e.g. Perquin et al., 2013; Bak, Nissan, Allerhand, & Deary, 2014; Antón et al. 2014; Goriot, Denessen, Bakker, & Droop, 2016). In one of the sparse studies on this topic, Keijzer and Schmid (2016) investigated executive function advantages among 29 elderly, long-term, immersed Dutch bilinguals (71+), who all started using their L2 English post puberty (mean AoA 27.23). This late bilingual experience seemed to result in an advantage for some and an overloading effect for others. No group differences were attested on any of the cognitive tests constituting the test battery (working memory span, Simon task, Stroop task) – i.e. no general BA was attested. Congruent with these findings, a number of studies have found little difference between bilingual and monolingual older adults in their performance on language tests (e.g. Kavé, Knafo, & Gilboa, 2010; Ashaie & Obler, 2014). There is just one (training) study that has investigated the effects of bilingualism on language learning IN the third age, namely Cox's (2017) analysis of differential effects of computer-mediated instruction in 45 older adults (aged 61–82), who were either monolingual or bilingual, learning novel Latin morphosyntax. While all participants showed significant gains in accuracy in tasks that required interpretation (written and aural), grammaticality judgment, and production (written), bilinguals showed an advantage over monolinguals, regardless of instructional condition.

Even more important is the question of whether the effects of long-term bilingual experience on executive functions are comparable to those of short-term FL training. What is more, besides neuro-cognitive factors, our understanding of the L2 learning process in individuals in later life should also take into consideration the cognition-affect interface: Social activities and social engagement – both of which are promoted through L2 learning – have been shown to be beneficial for the preservation of cognitive capacities (Ballesteros et al., 2015). Thus, how do we know whether this is indeed due to L2 learning or bilingualism and not to engaging in activity in general? It could be that the effect that is being observed for these training conditions is in fact an effect of increased social participation, a feeling of belonging and meaning, that is facilitated through language learning, but might equally be facilitated through other types of meaningful activity (see García-Pentón, García, Costello, Duñabeitia, & Carreiras, 2016 for a discussion of these methodological concerns). Language plays an intricate role in the ageing process; because of the interactions with social, cognitive and physical factors 'it is a methodologically difficult factor to extract from other social aging processes' (Pot, Keijzer, & de Bot, 2018b, p. 2). L2 acquisition in the third age thus needs to be regarded not just as a goal in itself

but as a means of promoting social interaction and integration, and that it is partly through the stimulation of social well-being that its cognitive effects may potentially be observed. Similarly, it is extremely difficult to distinguish processes of L1 attrition from processes of age-related changes (e.g. Goral, 2019; Keijzer & de Bot, 2019).

3.3 Socio-affective influences on adult SLA and use

In light of the fact that the acquisition and use of language in later life are informed by ‘a confluence of personal, social, and historical factors’ (Divita, 2014, p. 94), we now focus on empirical research that has analysed inter-individual differences that are age-independent as well as questions of volition and agency as they affect motivation to learn and to re-learn languages, age within contexts of lifelong language learning and multilingualism, and the construction of ageing identities within educational and multilingual settings.

As mentioned above, while the brain may remain plastic enough to learn new skills, there is evidence that older adults learn in different ways and that individual differences among them may pertain to factors other than age (e.g. Cox, 2013; Krakenberger, 2014; Ramírez Gómez, 2016; Pot et al., 2018a). According to Gilleard and Higgs (2010), the third age is a ‘cultural field predicated upon the agency of its participants’ (p. 123) and capable of sustaining multiple meanings and numerous opportunities for choice, autonomy, self-expression, and pleasure in later life – but also characterised by a resistance to be the social categorisation of the ‘othering’ of later life, as described above.

In older adults in a school context, scholars have observed apprehension and bewilderment vis-à-vis the learning environment (Brändle, 1986), low coping potential, lack of self-confidence – i.e. orientation towards failure and weak perception of possible success (e.g. Gómez Bedoya, 2008; Linhart-Wegschaidner, 2010). In a naturalistic setting, Cox (2019) argues that older adult immigrants may be WILLING to communicate in the target language, but lack opportunities to do so due to long working days, L1-based social networks, and/or social isolation. Limited opportunities for practice can feed into greater language anxiety and L2 avoidance (Sevinç & Backus, 2017). Documenting stories and experiences gathered from a four-year family literacy programme in a US public library system, Arxer, del Puy Ciriza, and Shappeck (2017) discuss minority ageing and how both public and private initiatives are framed with older adults in mind to promote successful language resocialisation. In doing so, they touch upon two important themes: the intersectional character of ageing which includes issues of race, ethnicity and immigration, as well as the focus on capturing the voices of minority elders about their use of an additional language: how does language learning shape family relationships, the workplace setting and notions of self-identity? Their qualitative analyses reveal that both late-life ageing and acculturation as socio-affective phenomena have the potential to produce feelings of isolation and loneliness. The lack of sociopragmatic and linguistic skills in the target language adds to the challenges older immigrants face to access specific services and integrate their lives into their surrounding environment. However, experiences vary among individuals (see also Goral, 2019).

Analysing the mediating role of language in the ageing process of 42 ‘first-generation’ Turkish migrants aged 52–84, Pot et al. (2018b) concluded that limited L2 skills may steer the ageing process in a detrimental direction for those older migrants who lack a social support network in the L1 and cannot communicate effectively in the L2. It is thus not simply the presence or absence of language skills that puts older migrants at an advantage or disadvantage with regard to managing their ageing process, but the way in which individuals handle communicative situations in the L2 environment. Moreover, cognitive abilities, issues of identity formation and environmental opportunities to interact are pivotal in advancing L2 development and increasing L2 usage (see also research on ageing and migration in Europe looking into living situations of older migrants, mobility patterns, access to social services and care practices, e.g. Bolzman, 2013; Karl & Torres, 2015).

Brill-Schuetz and Morgan-Short (2014) demonstrated that only learners with high procedural memory showed an advantage in implicit L2 learning conditions. Brändle (1986) mentions that there are often problems of apprehension in relation to the learning environment – often vastly

different from the school rooms and campuses of learners' youth. By contrast, other commentators have remarked that many older students – whatever their subject matter of choice – return to the classroom with excitement and very high motivation levels (see Hillage, Uden, Aldridge, & Eccles, 2000), which may lead to a substantial increase in well-being (Ware et al., 2017). Researchers such as Brändle (1986), Johnstone (2002) and Lenet et al. (2011) comment favourably on older learners' general command of reading skills, their understanding of grammatical principles and the way in which they cope with lexical learning.

One claim about third-age learners that frequently crops up is that they are intrinsically motivated. Thus, Edlinger (2016, p. 299; *our translation*) offers the following interpretation of third-age motivation research:

Older learners are strongly intrinsically motivated; they learn out of self-determination and less to achieve external goals. The investigation showed that their action is determined by the satisfaction of the need for autonomy. The question arises whether the need for autonomy plays a larger role in older learners than in younger learners. Conclusions could be drawn from this regarding an age-appropriate didactic approach.

Along not dissimilar lines, Matsumoto (2019) relates third-agers' motivation to Bryant and Veroff's (2012) concept of 'savouring' – attending to, appreciating, and enhancing positive experiences – and illustrates the phenomenon from her own work based on interviewing L2 learners in their 60s and 70s in Japan. These observations cry out for closer scrutiny: given that older adults choose to learn another language for many different reasons, it is important to talk about their motivation with an eye towards the (co-varying) issue of self-regulation. How do older adults go about this? How do they self-monitor? How do they evaluate progress and renew goals?

Finally, learners' potentially negative preconceptions about themselves also play a vital role. Knowles (1980) expresses the view that in groups of the mature and the elderly, it is psychological factors of affectivity that will determine how they approach their educational needs. In particular, he believes that they have a low coping potential, lack of self-confidence and are therefore more oriented towards failure. Older learners (60+ years) have often been found to exhibit self-defeating preconceptions regarding their learning abilities, probably influenced by widely held notions regarding old age or infelicitous contextual factors. This can be characterised as a sort of internalised ageism (see Roumani, 1978; Schleppegrell, 1987; Andrew, 2012). Older learners often appear to believe that the changes they have experienced in the course of ageing will have a negative impact on their later language learning capacity and progress. They may assume that, despite their efforts, their results will be poor, which is patently heavy with consequences for their engagement in learning activities (Ramírez Gómez, 2016).

3.4 Age stereotypes

There has been much discussion of the impact on third-age learners of ageist views and stereotypes (e.g. Andrew, 2012; Ramírez Gómez, 2016; Oxford, 2018). Although 'old age' as a distinct social category may have collapsed, age stereotypes still exist across the globe (Butler, 1975; Bytheway, 1994; Isopahkala-Bouret, 2015). Particularly fourth agers are often stereotyped as unattractive, elderly, sick, frail, dependent, decrepit, forgetful, and incompetent (Rodríguez Freitas Silva, 2008; Gilleard & Higgs, 2013; Mortimer & Moen, 2016). Even relatively young people can be targets of damaging ageist stereotypes.

In particular, the widespread reliance on chronological age for social organisation creates 'age effects' as self-fulfilling prophecies. Baars (2010) suggests that if we organise an action based on the idea that it is consequential on age, that is what it becomes. Any understanding of the 'influence of age' over a certain outcome requires an understanding of the role of age in the social organisation

of that outcome. Similarly, Ramírez Gómez (2016) observed that, fuelled by social stereotypes, many FL instructors believe that older learners' primary motivations to study an FL are socialising and leisure – leading to a patronising attitude towards these learners' abilities and the setting of undemanding goals. Along these lines, Andrew (2012) discusses how the biological processes of decline concurrent with age have been appropriated as the social view of ageing, which has led to both ageist and non-ageist views. In Gómez Bedoya's study (2008), in which 251 Japanese learners of Spanish in multi-aged classes were interviewed (40 of whom were older than 60 years), only half of the participants felt that age had a negative effect on their L2 attainment; the other half reported noticing no effect. Also, the older learners were more motivated and dedicated than younger learners, and the individual differences discerned pertained to personality traits (e.g. shyness) rather than age. If participants noted a disadvantage of age, they mostly referred to decreased memory capacities, but none of the participants supported the idea of age-separated learner groups (see also Singleton, 2018).

The philosopher David Norton maintains that ageist stereotypes occur because it is difficult to see beyond the perspective of one's current age (Norton, 1976). Older people may thus become aware that they have a new set of priorities distinguishing them from other age groups, yet still perceive themselves as relatively unchanged. Observers, on the other hand, may perceive physical changes yet miss changes in existential priority and agency. If later life is judged in terms of the criteria of maturation, it may exhibit itself to be mere deterioration. Old age may then be defined by weakening capacity, loss of youthfulness, loss of a good position in the workforce, decline, loss of influence, dependence, or the loss of partners. If accepted as true, 'lower ability to learn' and 'resistance to change' stereotypes can threaten the self-perception, identity and agency of individuals later in life (Isopahkala-Bouret, 2015).

Stress is a factor that induces deficits in declarative memory and affects hippocampal function as well as the network of cortical and subcortical regions involved in cognitive control (e.g. Sousa, 2016). Green (2018, p. 40) suggests that '[c]hronic stress may then be an impediment to the learning and use of an L2 in older adults for whom these regions and their interconnections are already compromised. If that is so, individuals such as refugees from war living in a new culture with an urgent need to learn its language, may be the ones for whom learning an L2 will be most problematic'.

Resisting ageist stereotypes might thus reduce or prevent age-related physical and other declines (Levy, Zonderman, Slade, & Ferrucci, 2009). In general, an individual's perception of her cognitive abilities (whether these are 'fixed' or flexible across the lifespan) has direct repercussions on the ability to learn and adopt a positive mindset (Dweck & Molden, 2017). Sigelman and Rider (2012) note that older adults can maintain self-esteem by comparing themselves with other older adults, rather than with younger adults. Oxford (2018) reasons that if third-agers apply ageist stereotypes to themselves, their self-esteem suffers, but if they attach these stereotypes to other older adults, they feel better about themselves. Levy's (2003) research shows 'that activating POSITIVE stereotypes of ageing ... may boost [older people's] performance, at least temporarily' (in Sigelman & Rider, 2012, p. 366, emphasis added; see also Levy & Langer, 1994). On the other hand, if third-agers accept ageist stereotypes as true, self-stereotyping occurs, and it may cause dangerous decline, as mentioned above: according to Oxford (2018) older language learners must be surrounded by a supportive community that believes they have the capability to learn and are purposeful and autonomous.

Ageist attitudes also have a tendency to continue to exist within processes and practices that on the surface appear to promote inclusion. For instance, over the past 40 years, social research has countered assumptions about the inevitable degeneration of individuals in later life by promoting a positive perspective on ageing (see e.g. Johnson & Mutchler, 2014). However, many linguists continue to approach the speech of older individuals as a static repository of vestiges from earlier stages of the language, or as a reflection of physical and cognitive decline. There is a serious lack of attention to understanding the social process of ageing as opposed to the common-sense depiction of ageing as decay and forgetfulness (Rughiniş & Humă, 2015). Such decline narratives cannot be found in other realms where similar phenomena occur. For instance, Ramscar et al. (2014, 2017) compare the well-documented decline in information-processing speed of individuals in later life to bilinguals' lexical processing performance.

The response latencies of young bilinguals in picture-naming tasks resemble older monolinguals more closely than young monolinguals or old bilinguals; and younger bilinguals exhibit slower response times and increased tip-of-the-tongue rates as compared to younger monolinguals (see Gollan & Acenas, 2004; Gollan, Montoya, Cera, & Sandoval, 2008). Although younger bilinguals exhibit slower response times and increased tip-of-the-tongue rates as compared to younger monolinguals, these differences are not usually thought of as deficits. Rather, the opposite conclusion tends to be drawn: bilinguals' lexical processing performance is seen to reflect the natural demands associated with bilinguals' larger vocabularies.

4. How older adults may benefit from L2 learning

We turn now to the question of how good additional language learning is for older learners. As mentioned above, L2 learning has been hypothesised to contribute to healthy and active ageing, to be a strategy in later adulthood to maintain and enhance 'healthy' ageing – since it is a cognitively challenging – to promote neural plasticity and foster social interaction, individual mobility and autonomy (e.g. Rönnlund, Bäckman, & Nilsson, 2005; Park & Reuter-Lorenz, 2009; Antoniou et al., 2013; Green, 2018).

However, while long-term active use of two languages seems to be neuroprotective, we lack studies of the potential neuroprotective effects of the learning and use of an L2 later in life. There are only a few existing studies investigating the relationship between SLA in older adults and the effects of such L2 training on cognition. Moreover, such research has to be relatively complex in its design in terms of sample size, number of measurements per participant, types of control groups, intensity of L2 training, suitability of L2 teaching methods, theoretical and statistical model formulation and interactions between the predictors under investigation. As Ramos, García, Casaponsa, and Duñabeitia (2017, p. 46) point out, 'establishing a direct link between a specific training in language control or in language acquisition and a consequent improvement of non-linguistic control may not be an easy endeavour'.

We refer below to the results of (1) intervention studies focusing on the effects of L2 learning on older adults who begin the relevant language learning process in old age versus studies that involve participants who have already had years of linguistic experience with an L2; (2) longitudinal studies versus studies that present snapshots of states; and (3) intervention studies conducted in naturalistic settings versus school contexts.

First results of such intervention studies suggest that

- (a) language learning supports non-auditory neural plasticity in cognitive-related brain areas (frontal lobe) (Schlegel et al., 2012; Stein et al., 2012);
- (b) cognitive fitness constitutes a major factor explaining the variance in FL development as a function of L2 training in a school context – see e.g. Kliesch, Giroud, Pfenninger, and Meyer (2018), who found a significant relationship between participants' L2 growth and verbal fluency and working memory;
- (c) participants' cognitive capacities seem to be more predictive of L2 progress in later life than age in naturalistic settings; i.e. only older adults with the largest working memory capacity show significant gains in L2 learning (see e.g. Mackey & Sachs, 2012);
- (d) even a short period of intensive language learning can modulate attentional functions (e.g. attention switching) from which both older and younger learners can benefit (Bak, Long, Vega-Mendoza, & Sorace, 2016); such cognitive benefits have also been found in delayed post-tests after six months of intensive FL learning via computer-based language training software and computer games (Wong et al., 2019) – although the opposite has also been reported (see e.g. Berggren et al., 2018; Ramos et al., 2017);
- (e) there are advantages in additional (instructed) language learning for late bilinguals compared to monolinguals regardless of type of instruction (Cox & Sanz, 2015; Cox, 2017);

- (f) effects measured during sentence comprehension using electroencephalography (EEG) become more similar between native speakers and adult L2 learners as a function of proficiency (Dowens, Vergara, Barber, & Carreiras, 2010; Soskey, Holcomb, & Midgley, 2016); furthermore, for older learners who make more L2 gains, switching between the L1 and the L2 is less effortful than for those with lower L2 proficiency after training (Van Der Meij, Cuetos, Carreiras, & Barber, 2011; Prat, Yamasaki, Kluender, & Stocco, 2016; Kliesch et al., 2018);
- (g) although some implicit forms of learning – particularly those involving the acquisition of subtle probabilistic sequential regularities – show age-related declines, older adults are capable of statistical learning of the distributional information underlying grammatical form class categories, following brief auditory exposure to a subset of possible strings of the language (Schwab et al., 2016);
- (h) despite equivalent performance, distinct neural networks characterise the ceiling of young and elderly French-speaking participants trained by means of a computerised Spanish word program (Marcotte & Ansaldo, 2014);
- (i) the degree of difference in learning success between older individuals is predicted by various factors that may modulate benefit, such as prior knowledge of more than one language, which results in more successful L2 development (Pfenninger & Polz, 2018), language typology, bi-versus multilingualism, and age of acquisition (Antoniou & Wright, 2017);
- (j) learner investment is likely to interact with the cognitive capacities of older learners, such that high cognitive demand leads to exhaustion, which may increase perceptions of low learning abilities and tiredness and reduce motivation (Ware et al., 2017);
- (k) L2 learning plays a key role inasmuch as it addresses socio-affective issues – i.e. by preventing isolation, fostering linguistic flexibility, self-esteem and autonomy (Antoniou et al., 2013; Pot et al., 2018a).

One of the few behavioural studies investigating the relationship between L2 learning in older adults and cognition which made use of L2 training based on communicative tasks and interactional feedback is Mackey and Sachs's (2012) study of the effect of inter-individual differences in cognitive capacities on L2 learning success in older adults. Their research involved nine Spanish-speaking participants aged 65–89 ($M = 72$, $SD = 8.32$) who had lived in the US for an average of 17 years, and so were not yet in the third-age category when they started learning the L2. They engaged in a variety of communicative tasks five times over a five-week period. The results of three post-tests reveal that participants' L1 listening-span capacities were more predictive of their L2 progress than age. However, Mackey and Sachs's findings are of restricted generalizability, since (1) the training focused only on the acquisition of one particular linguistic feature and is therefore not representative of L2 acquisition in general; (2) although the training was purely auditory, hearing skills were not controlled for, which means that differences in L2 improvement could simply be due to differences in sensory acuity.

Schlegel et al. (2012) followed young adults, assessing white matter structural plasticity using diffusion tensor imaging during intensive L2 training in Modern Standard Chinese and compared them to controls who were not participating in any L2 programme. Compared to the controls, the L2 trainees exhibited higher integrity in language-relevant white matter connections between auditory and frontal brain regions in the left and right hemisphere as a function of the training. Furthermore, the increase of the integrity in the white matter connections correlated with the individual increase of the grades achieved in the L2 class. Investigating grey matter structural plasticity, Stein et al.'s (2012) study pointed to a similar correlation between the increase in cortical thickness in the left inferior gyrus and the increase in proficiency of L2 acquisition, which was independent of the absolute L2 proficiency level. Such correlations show that it is mainly inter-individual differences of the proficiency increase that are reflected in brain plasticity rather than the initial or resulting PLs. Thus, there is conclusive evidence for substantial structural and functional neural plasticity in adulthood as a function of inter-individual trajectories of learning during L2 acquisition.

In Kliesch et al. (2018), an EEG experiment was conducted after an intensive English course (four hours a day, i.e. 60 lessons over the course of three weeks) with ten German-speaking ‘young-olds’ (monolingual Swiss- or High-German native speakers, mean age = 68.20, SD = 2.44, range = 65–74) who were controlled for musical training, hearing ability, use of English (beginners), amount of time spent in an English-speaking context, neurological, psychiatric or language disorders, IQ and physical activity. One of the goals of this study was to investigate participants’ processing of L2 sentences and learn about their ability to (1) switch between the new L2 and their native language and (2) predict meaningful sentence endings in the L2. The results showed a typical N400 component with a centro-parietal distribution in the time window between 300 and 450 ms with larger amplitudes in the switch conditions compared to the non-switch conditions. In other words, the EEG data indicated that for participants with higher L2 knowledge, switching between English and German was less effortful than for those with lower L2 proficiency. This replicates the findings of Van Der Meij et al. (2011), who also found an effect of switch on N400 amplitude.

To be noted, however, is that the opposite has also been found – e.g. in Berggren et al.’s (2018) study with a sample of 160 healthy older participants aged 65–75 years (Swedish speakers with no prior knowledge of any Romance language – although it is not clear if there were any bilinguals among them), who were randomised to 11 weeks of either language learning or relaxation training. Participants in the language learning condition met twice per week over 11 weeks for 2.5 hours each class. Cognitive performance was assessed two weeks before (pretest) and one week after the intervention (post-test), including tests of spatial intelligence, verbal intelligence, working memory, long-term associative memory and item memory. Language gains were measured through ‘a vocabulary test consisting of 110 words randomly sampled from the chapters completed during the course’ i.e. a translation task. Although the participants were able to acquire ‘a basic Italian vocabulary’, the authors argued that ‘this is not due to either poor measurement, low course intensity, or low statistical power, but that language learning in older age is likely to have no or trivially small effects on cognitive abilities’ (p. 1). The authors’ focus on vocabulary, however, is regrettable, considering that in many immigrant studies (e.g. Clahsen & Felser, 2006; McDonald, 2006, 2008; DeKeyser, Alfi-Shabtay, & Ravid, 2010; Granena & Long, 2013) it is pointed out that L2 morpho-syntax and phonology seems to be more vulnerable to processing difficulties than L2 lexico-semantics and more susceptible to age. Such difficulties have been linked to resource limitations that might lead to the inability (a) to access and retrieve stored L2 knowledge (semantically related difficulties) and/or (b) to detect phonological discriminations in the input (phonologically related difficulties), similar to the difficulties of native speakers under specific types of stress manipulation (McDonald & Roussel, 2010; Pfenninger, 2011). However, recent accounts predict starting age effects on lexical behaviour (see e.g. Hernandez, Li, & MacWhinney, 2005; Hernandez & Li, 2007; Hernandez, 2013; Li & Grant, 2015; Bylund, Abrahamsson, Hyltenstamb, & Norrman, 2019; Hernandez et al., *in press*).

Ramos et al. (2017) also reported no benefits after an eight-month-long language training for 26 Spanish monolingual elderly learners of Basque in the Basque country (Spain) who were able to use the L2 beyond the classroom. Hypothesising that L2 training might boost switching between mental sets and increase inhibition ability, the authors failed to find a significant difference in switch costs between their experimental and control group (Spanish monolinguals who received no L2 instruction). Pot et al. (2018a) suggest that this might have to do with the fact that Ramos et al. (2017) merely looked into improvements with respect to switching ability as opposed to, e.g. inhibitory control or attention, as tested in Bak et al. (2016). Pot et al. further point out that Ramos and colleagues made no reference to social engagement benefits, even though cognitive engagement and stimulation, especially through language learning, may have effects in the social or biological domain of ageing. Pfenninger and Polz (2018) found that personal motivation, self-study effort, learning progress and social aspects appeared to be co-dependent at least for some participants; it thus makes sense to include (psychometric) tests that probe the learners’ environment, history and personality. A similar picture emerged in Ware et al. (2017), who conducted a four-month pilot study (16 two-hour sessions)

with 14 French participants: five beginners, five intermediate, and four advanced learners of L2 English. Three measures – semi-structured qualitative interviews, the Montreal Cognitive Assessment (MoCA) test and the University of California Loneliness Assessment (UCLA) scale – were administered before and after a technology-based intervention to measure cognitive level and feelings of loneliness or isolation. Their qualitative analyses shed light on the social benefits of L2 learning in the third age: most of the participants found the programme to be stimulating and enjoyable and were eager to learn more, motivated by the feeling that their engagement in educational activities allowed them to stay involved with the outer world.

This is in line with Erikson's (1982) model of psychosocial development. Lifelong education offers seniors new opportunities for overcoming a state of isolation, stagnation and despair by offering contact with other seniors (and not only them), involvement in developing one's knowledge and skills (e.g. language skills) and more than anything else, it can give a new aim to life (see also Gabrys-Barker, 2018). Ybarra et al. (2008, p. 257) point out that 'social interaction and relationships not only sharpen our knowledge and social skills, but also strengthen the cognitive processes that underlie those skills'. Cattan, White, Bond, and Learmouth (2005) synthesised 30 quantitative outcome studies, 12 qualitative as well as evaluation studies and surveys involving interventions designed to prevent isolation and loneliness among older adults. Interventions judged to be effective included interventions with focused educational input and those enabling 'some level of participant control' (p. 57; see also Shapira, Barak, & Gal, 2007). Swain and Lapkin (2011) emphasised that language plays a vital role in this as it mediates cognitive processes such as attention, recall, and knowledge creation, each being important aspects of cognitive enhancement. What is more, enhanced self-esteem experienced by participants in intervention studies might be a result of their interaction with the researchers.

Keijzer's project 'VIDI' proceeds from the assumption that no two bilinguals are the same and bilingualism effects are therefore not universally reported, leading to questions regarding its validity (see Paap et al., 2015). She proposes a new impetus to the field of bilingualism but also its applicability in healthy ageing, through:

- (1) an epidemiological study that relates individual differences in bilingual experiences to healthy ageing outcomes in a sample of more than 12,000 65+ North Netherlanders. Differences include languages or dialects spoken, age at acquisition, intensity of use, and language attitudes;
- (2) introducing an FL learning experience to a functionally monolingual group of healthy seniors and those diagnosed with Mild Cognitive Impairment or Late Life Depression over the course of six months.

This two-step design is expected to shed new light on two important questions: the nature of the BA in old age and how learning a new language after the age of 65 enhances cognitive flexibility and well-being levels in healthy and non-healthy elderly people.

Recruiting older Turkish women (first-generation migrants) in the Netherlands, Pot (*in prep.*) analyses multilingual ageing from two perspectives: the advantages that present themselves to multilingual elderly such as Frisian and bidialectal speakers in the North of the Netherlands but also the detrimental health and social effects of growing old in an environment where the dominant language is not your mother tongue. In another current Ph.D. project in Groningen, van der Ploeg explores what the best way is to teach older adults a new language. Partly on the basis of a project tapping older adults' preferences regarding third age language learning, an implicit and explicit language condition were created and their effectiveness assessed.

Finally, in a project in Germany, Grossmann, Teichmann, and Meyer (*in prep.*) are currently investigating the effects of L2 learning on cognition in older adulthood, dividing 60 native German-speaking healthy older participants aged 65–80 years into a training group and a control group. Language learners attend English classes for beginners for 1.5 hours a day, five days a week for three weeks. Changes in executive functions, attention, and episodic memory are determined

through assessment before and after participation in the classes. Participants in the control group will also be assessed twice within the same time frame but will attend language classes only after the second measurement so as to determine WHEN first cognitive changes occur. Nine months after the training a post-test will be conducted.

All of these studies are product-oriented rather than process-oriented and therefore risk ‘decontextualizing, segregating, and atemporalizing’ language development according to Larsen-Freeman and Cameron (2008, p. 252). However, our contemporary understanding of SLA views it as a complex, dynamic, ecologically situated, multivariate phenomenon – hence the impact of theories like chaos/complexity theory (Larsen-Freeman & Cameron, 2008) and dynamic systems theory (de Bot, Lowie, & Verspoor, 2007; Lowie, 2017). These characteristics of language development can make it extremely difficult to adopt traditionally formulated, linearly framed research methods (Lorenzo, Moore, & Casal, 2011). This makes the non-reductionist, ecological, systems view afforded by dynamics and complexity theories – henceforth referred to as Complex Dynamic System Theory (CDST) (Larsen-Freeman, 2017; Pfenninger & Neuser, *under review*). CDST is a meta-theory of change which describes relationships among embedded subsystems that cannot be assumed to be linear, based on the idea that intra-learner variability is a necessary condition for development (de Bot et al., 2007). This approach fundamentally questions the feasibility of investigating cause-effect relations, the traditional basis of generalisable theories. Since it is unlikely that a single cause (or a handful of independent variables) will give rise (in a linear fashion) to such a complex event as L2 learning, the suggestion is to focus on ‘tendencies, patterns and contingencies’ rather than simple cause-effect explanations (de Bot & Larsen-Freeman, 2011, p. 23). CDST also requires us to revisit the idea of predicting behaviour, considering that no two situations can be similar enough to produce the same behaviour (Larsen-Freeman & Cameron, 2008). In sum, in a complex world, we lose predictability; the nature of explanation changes; and cause and effect work differently (Larsen-Freeman & Cameron, 2008, p. 72). Along those lines de Bot and Makoni (2005) propose a dynamic model of language use in ageing, in which ageing is regarded as a system that develops under the influence of changes within the individual (physical and psychological) and external changes relating to attitudes towards ageing in society, and an individual’s perception of this.

Such a process-oriented approach is currently used to analyse data from a longitudinal study with dense measurements called ‘Dynamic analyses of language learning in the third age (DYNAGE3)’ at the Universities of Salzburg and Zurich (Benisowitsch, *in prep.*; Haselsberger, *in prep.*, Kliesch, *in prep.*). Some of the key questions asked are (1) when L2 development is statistically significantly increasing (or decreasing), and (2) whether the set of predictors in question (age, cognitive fitness, bilingualism, affect) have a significant effect on the trajectories under investigation. The data set contains 80 learning trajectories (i.e. 40 participants on a mono/bilingual continuum in the experimental group, 20 participants in the active control group, and 20 participants in the passive control group), each of them represented by 30 measurements taken at equal intervals over one year, amounting to 2,400 data points per participant and test. Participants are tested on a range of cognitive, linguistic, neurofunctional, and socio-affective parameters, with the aim of identifying factors that facilitate successful learning and help explain inter-individual differences that are age-independent. In such a study it is critical to include a passive control group as well as an active control group engaging in another type of training that does not involve the use of language (see e.g. Basak, Boot, Voss, & Kramer, 2008; see also Hargreaves, Pexman, Zdrzilova, & Sargious, 2012). Analyses such as these reveal learners’ individuality in the FL learning process and enable applied linguists to identify consistent patterns of individual differences as well as phases with significant increase/decline – and the factors that cause them. A particular emphasis will be on the role of social participation, a feeling of belonging and meaning, that is facilitated through language learning. Is there any evidence that actual use of the learned L2 makes a contribution, whether direct or indirect, to the highly desirable state of social well-being?

5. Teaching additional languages to third age learners

As a consequence of current demographic changes, third-age universities are flourishing throughout Europe (e.g. ‘Uni 55plus’ in Austria, ‘Senioren-Universität’ in Switzerland, ‘Universités du troisième Age/Tous Age/du Temps Libre’ in France, ‘Uniwersytet Trzeciego Wieku’ in Poland). Furthermore, the last decade of the twentieth century saw the emergence of ‘critical educational gerontology (CEG)’, a field which ‘conceives older adults as in control of their thinking and learning, and more importantly, as capable of further development’ (Formosa, 2002; quoted in Ramírez Gómez, 2016: 96). CEG addresses the relations between ageing, economic conditions, and the activity of the state in regard to educational policy vis-à-vis older adults – education that liberates rather than oppresses (see e.g. Warnes, Friedrich, Kellaher, & Torres, 2004; Warnes & Williams, 2006; Ramírez Gómez, 2015). An increasing body of research focuses on the extent of older adult success in *WHAT* and *HOW* they learn (Hartshorne & Germine, 2015; Amer, Campbell, & Hasher, 2016), rather than possible failure to learn as much or as quickly as young adults. ‘Best practice’ in older adult language education has developed little since the 1980s, when Joiner (1981) devised an optimal, goal-driven learning programme with individualised, self-paced instruction at its core, and the inclusion of real-world materials to link learning to practice and boost motivation.

According to Knowles, Holton, and Swanson (2011), there are three sets of variables especially worth considering in adult education:

- *Core learning principles*: the learner’s self-concept, prior experience, readiness to learn, orientation to learning and motivation, and learners’ need to know *WHY* they are learning what they are learning.
- *Individual and situational differences*, which include subject-matter differences (e.g. the level of complexity of the content), situational differences (e.g. location, number of learners in the class) and individual differences (e.g. personality, learner background).
- *Goals and purposes for learning*, which help coordinate the effort and direction of the learning process; according to Beder (1989), these may have an individual, institutional or societal nature.

According to certain scholars (e.g. Grotek, 2018) benefits may be observed only if participants feel ‘safe’ and at ease in the learning environment. This is claimed to be achievable via small (homogeneous) groups, a positive stance towards participants’ L1, and the use of non-threatening material in the form of relatable, restricted content, visual cues and an absence of digital materials (despite the learning benefits claimed for these) (Schleppegrell, 1987) – see also the main principles of ‘critical foreign language pedagogy’ outlined in Ramírez Gómez (2016, p. 108). Several authors (e.g. Oxford, 2018; Pawlak, Derenowski, & Mystkowska-Wiertelak, 2018; Piechurska-Kuciel & Szyszka, 2018) recommend conducting strategy instruction, woven into language teaching, and involving activities from ‘sage-ing’, i.e. a ‘late-life ... process that enables older people to become spiritually radiant, physically vital, and socially responsible ‘elders of the tribe’, who are full of ‘meaning and purpose’ (Schachter-Shalomi & Miller, 1995, pp. 5–6), mindfulness (see also Tolle, 2004; Williams & Penman, 2012; Kabat-Zinn, 2013), and the selection, optimisation, and compensation process (see also Derenowski, 2018).

Third-agers’ prior experience of learning and mental models provides the resources which may facilitate their coping with a new learning situation in later life (Knowles et al., 2011). Park et al. (2014) showed that in older adults, the beneficial effect of productive engagement in demanding tasks and involvement in a social setting is highest if these are combined, accordingly underlining the importance of social exchange in cognitive training interventions with older learners. Thus, the immediate feedback provided by an instructor and the interaction between instructor and learner may also play an essential and beneficial role for both the learners’ motivation and the learning outcome.

Oxford (2018) emphasises that any differentiation of language instruction for teaching third-agers should take into account interests and desires; adjust instruction to learners' sensory preferences and abilities; provide instruction that matches learners' cognitive levels, cognitive styles, and PLs in the language being learned; and tune instruction to the level and types of learning strategy in use. According to Chamot (2017) differentiation also includes paying attention to diversity in personality factors, motivation and willingness. Learners of all ages benefit from seeing that they have options in respect of how to express themselves: 'every time they use language, they are making choices, and by so doing, negotiating their identities' (Larsen-Freeman, 2017, p. 28).

6. Extending the research agenda

One of the challenges in this line of research is the prevalent 'deficit view' inadvertently included in the representation of research findings: evaluating older language learners against 'young learner' competence, i.e. setting the criterion for 'success' in L2 as the level of proficiency associated with young adults; participating in a rhetoric of age as an internal causal factor, thereby de-socialising age (Rughiniş & Humă, 2015); estimating ageing effects in the aggregate, i.e. grouping third-agers into cohorts according to their age, thus dismissing people's agency in shaping their lives, and the role of social variation and change (Rughiniş & Humă, 2015); using patronising teaching materials (e.g. explicitly labelled 'adult learner' course books); using tasks for the comparison of age groups that compare performance between groups whose experience varies; speaking about the third-age learner as a failure for being unlike the younger learner and about lifelong learning 'as a practice to battle against old age' (Isopahkala-Bouret, 2015, p. 2); and finally, anticipating, through the statistical parlance about 'age effects', matter-of-factly representing them as underlying deficient behaviour (Rughiniş & Humă, 2015).

The main question is, to use Rughiniş and Humă's (2015, p. 147) words: 'how can one avoid methodological reductionism in interpreting findings, so that the "age effect" is not implicitly rendered synonymous with depreciation?' Getting rid of stereotypes in research design, task design and data analysis is a fundamental step towards understanding age-related changes and age parameters in SLA, and, by extension, encouraging older language learners and creating more positive ageing identities not only at an individual level but at a societal level. Focusing on within-learner generalisability – rather than between-learner generalisations – might be a step in the right direction, considering that (1) there is particularly great inter-variability and heterogeneity among older adults, which makes statistical generalisations across subjects almost impossible, and (2) L2 learning is a complex, non-linear process. Dynamic systems perspectives (see Ortega & Han, 2017) on third-age learning are particularly appealing if we want to make a distinction between chronological age and social or 'contextual' age; the former is understood to be a 'predictable, even ineluctable progression along an incremental scale,' while the latter is 'a far less predictable ebbing and flowing, reflecting the arrival and passing of particular somatic, experiential and emotional circumstances' (Coupland, Coupland, & Giles, 1991, p. 140; see also Divita, 2014). In contrast to the intervention studies mentioned above, in which L2 learners in later life were tested only twice or thrice (usually at the beginning and end of L2 training), it is thus vital to make use of denser time serial measurements in order to focus on micro-development and idiodynamic trajectories, capturing and capitalising on individuality in the L2 learning process, homing in on variability, non-linear development, and progression in iterative steps (see Singleton & Pfenninger, 2019, for specific research agendas). Data from such iterated investigation of third-age learning will make a substantial contribution to research on late L2 acquisition as well as on cognitive aspects of healthy and active ageing. That way age ceases to be a 'predictor' and instead becomes a CORRELATE, in which typical ages are described by typical situations and configurations.

Another issue with the conceptualisation of third age is the prioritising of the concept of 'successful ageing' over the idea of 'harmonious ageing' in age-based discourse. In Liang and Luo's (2012) theory critique, the discourse of successful ageing is identified as problematic with respect to four dimensions: first, successful ageing is ageist in nature, and it produces a disharmony between body and mind. Second, the capitalist and consumerist components of successful ageing are under-addressed

(successful ageing is often used as the trademark for selling the idea of ‘lifestyles’). Third, successful ageing is a discourse developed on the basis of Western (specifically, American) values and may not readily apply to other cultures. Fourth, successful ageing overlooks the deeper concern of quality experience (e.g. it overemphasises frequency of activity participation). For instance, Carlson et al. (2012) found that participation in a variety of lifestyle activities is more predictive than frequency or level of cognitive challenge for significant reductions in risk of impairment on measures sensitive to cognitive ageing and risk for dementia.

Furthermore, knowledge about identity construction and the subjectivity of language acquisition and use in later life remains curiously thin. How do the interior and external logics of adult ageing compare, how is identity performed in different acquisitional settings, and what implications does this have for L2 acquisition and L2 pedagogy? How do particular approaches interact with age-identity? We need more studies that are distinguished by their focus on contingency and diversity rather than their focus on difference, studies that are based on encouraging third-age learners to develop and express their own ‘voice’ and to articulate in their own words what learning an additional language means to them. One way to resist age stereotyping is to let third-agers define for themselves the category of ‘ageing learner’ or ‘older learner’ and make sense of their ageing selves; lifelong learning clearly plays a part in new ageing identities. In Gilleard and Higgs’ (2013, p. 20) words, ‘these new ways of narrating and performing age have emphasised desire, potential and agency over need, vulnerability and limitation’. Along those lines, Eckert (1998, p. 165) recommends a shift in focus ‘away from chronological age and towards life experiences that give age meaning’ (1998, p. 165) – which explains the need for single-case studies and case-series studies, i.e. qualitative approaches.

Related to this, there is also the question of the extent to which research studies view third-age learners as human subjects of study, and to what extent they view them as co-participants, mobilising them to co-operate in the data collection process and/or in the development of teaching methodologies, thus contributing to the growing tradition of Citizen Science. Biggs (2005, p. 124) suggests that ‘the use of older researchers to research older people may go some way to reduce biases associated with the unequal distribution of power between researchers sponsored by state organizations and those who use their services.’

Since age-identities are managed as much in research situations as in any other (Biggs, 2005), it is also of utmost importance that younger researchers be sensitised to the dangers of imbalances in generational power, which can lead to biased data. Younger researchers cannot assume their questions will be perceived as neutral and that they are protected by a research persona; e.g. the identity presented to the researcher may only partially reflect the experience of ageing or the perspective of the older adult.

From a quantitative perspective, an important question concerns the methodologies needed to study complex dynamic SOCIAL systems. By working with age as a ‘socio-demographic variable’, quantitative researchers often convert it (inadvertently) into an exclusively quasi-biological feature (see Rughiniş & Humă, 2015), which does not do justice to the socio-affective and contextual nature of the age factor. Accordingly, statistical methods are necessary which are able adequately to analyse change and account for variability and auto-correlation in linear as well as non-linear patterns (i.e. the short-term and long-term developmental trajectories of older adults). Traditional ANOVA-based analyses, which run on averaged data and thus aggregate participants, define ageing as a uniform process across cohorts, thus encouraging a biological interpretation. In such analyses, it is COHORT that is of principal interest for researchers, and not AGEING, that is, changes in cohorts’ behaviour while they progress through life. As Rughiniş and Humă (2015) rightly point out, COHORT and AGEING represent two distinctive (and potentially contrary) sources of variability. Furthermore, sample-based research does not tell us about individuals. This is where the generalised (mixed-effects) regression framework comes into its own, including generalised additive (mixed) models (GAM(M)s), which represent an important statistical development of the last 45 years and provide an extremely useful set of tools for the dynamic analysis of linguistic data within the field of age-related research.

Finally, the findings presented in the intervention studies outlined above are preliminary at this point and the conclusions drawn from them must be considered against the methodological

constraints inherent in their design. However, such preliminary results, while requiring sensible critique, are encouraging and seem to warrant more research with larger sample sizes and different methodologies to obtain a clearer and more detailed picture.

7. Conclusion

A crucial component of the future agenda for this area proposed by Mackey and Sachs (2012) concerns the need to replicate the intervention studies referred to above with research involving larger sample sizes and different methodologies. Such an extended replication might enable us to obtain a clearer picture of cognitive capacities that vary as a function of age but which are also influenced by the extent to which intellectually stimulating activities are included in an individual's lifestyle (Cox, 2019).

This would have particular relevance to studies focusing on the effects of L2 learning in older adults who BEGIN the relevant language learning process IN old age. While there is research which suggests that the long-term active use of two languages may be neuroprotective, we lack studies of the potential neuroprotective effects of the learning and use of an L2 later in life. Particularly longitudinal studies and dynamic analyses of linguistic data may enable us to reach clearer conclusions as to the effects of such later language learning and use on, for example, domain-general executive control, both from a qualitative and a quantitative point of view. Considering the lack of success in developing effective pharmacological therapies to halt neurocognitive decline and prospective dementing illnesses (Hildreth & Church, 2015), a precise societal responsibility consists in identifying ecologically valid interventions aimed at promoting healthy ageing through neural and/or cognitive reserve mechanisms.

Current ideas about age-related cognitive decline are inexorably linked to the nature of the tests used to study the effects of age on cognition (Ramscar et al., 2017). Age-related declines in scores on neuropsychological tests are widely believed to reveal that human cognitive capacities decline across the lifespan. An increasing number of scholars, however, suggest that differences between older and younger adults' performance in neuropsychological testing are the product of the same cognitive mechanisms being required to process different quantities of information and that, when properly analysed, the learning processes in healthy adults in fact appear to function in a consistent way across the lifespan, older adults' performance thus reflecting 'increased knowledge, not cognitive decline' (Ramscar et al., 2014, p. 34). Neurobiological studies reveal only that the structure and/or biology of neural processing changes. Interpretation of such change 'as evidence of decline (or increased efficiency) requires a model of the relationship between neural activity and cognitive FUNCTION' (Ramscar et al., 2014, p. 35).

Finally, the outcome of more research on third-age additional language learning will have enormous repercussions on cost-effectiveness and treatments against age-related cognitive decline. Indeed, there are financial costs associated with these issues. In the US, data from about ten years ago reported that seniors made up about 13% of the population but consumed 36% of personal health care expenses, considering only the costs of treating cognitive decline (Agency for Healthcare Research & Quality, 2006). A National Institutes of Health (NIH) report (2013) claimed that in a single year in the US (i.e. 2010), the cost of cognitive decline, including nursing homes, medication and physician care, was \$215 billion. These figures underline the urgency of the problem. In Europe, these costs were estimated to reach €160 billion in 2008 (Wimo et al., 2013). Along similar lines, it will be important in the coming decades to gain a better understanding of how ageing and immigration intersect to impact language disparities in our older population (Arxer et al., 2017).

Questions arising

- (1) To what extent is 'age' as a construct of itself of relevance in the light of huge and increasing spread of individual abilities and skills as age progresses?
- (2) How can we methodologically tease apart language training effects from effects of increased social participation that is facilitated through language learning?

- (3) Related to point (2), how can we find out whether it is actual use of the learned L2 makes a contribution, whether direct or indirect, to the highly desirable state of social well-being and/or a potential BA?
- (4) Do later-life L2 learners when attempting to use their learned L2 in everyday real-life settings stay within the boundaries of the L2, or do they draw creatively on whatever repertoires of language to which they may have access, including the L2 that they are learning?
- (5) How does access to various resources impact on success and continuation with the endeavour of learning a new language later in life? For example, how is L2 use and contact with native speakers predictive of longer-term outcomes?
- (6) Does language training induce causal functional and anatomical (i.e. grey and white matter) changes and/or domain-specific plastic changes in the brain?
- (7) What kind of language training induces longer lasting functional/anatomical/cognitive after-effects of training?
- (8) What is the nature of processes of L1 attrition in ageing bilinguals who maintain both their languages into older adulthood? Is one language system more vulnerable to processes of ageing, i.e. can differential patterns of change be observed?

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