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Age-related effects

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15.1 Introduction

The idea that childhood is the optimal time for language acquisition appears obvious to the casual observer today as it has in the past. For example, the French writer Montaigne (1962 [1580]: 172–73) recommends starting a supplementary language (such as Latin, which he learned from infancy) at a very early age. The evidence for a critical period for first language acquisition seems clear, given that all typically developing children learn the language(s) in which they are immersed to gain native speaker competence as adults (Guasti 2002; Meisel 2008; Prévost 2009). For extensive discussion of age-based issues related to typical and atypical (e.g. SLI, Downs Syndrome, Williams Syndrome) first language acquisition (L1A), see Herschensohn (2007). Indeed, these facts and a number of other biological phenomena are adduced by Lenneberg (1967) to argue for a critical period for learning the native tongue, starting at age 2 and closing at age 12, i.e. puberty. However, Lenneberg is more cautious in addressing acquisition of subsequent languages, yet nonetheless concludes that “automatic acquisition from mere exposure” (1967: 176) is not possible beyond childhood. In the ensuing decades, his idea of a critical period was extended from its initial application to L1 acquisition to L2 acquisition in a range of research that appeared to corroborate age effects in L2A. Age of onset of acquisition (or AoA, sometimes referring to age of arrival for immigrants but also used to refer to initial exposure; details of use of the term are beyond the scope of this chapter) shows an inverse relationship with incidence of nativelike attainment in sampled populations, with increasing AoA roughly correlating with decreasing proficiency as measured, for example, by pronunciation accuracy (Scovel 1988) and grammatical accuracy (Johnson and Newport 1989). The clear existence of such age effects does point to an advantage in language acquisition for younger learners, but it is not sufficient to establish explicit temporal limits for a biological critical period (Birdsong 1999b;
Herschensohn 2007). This chapter summarizes earlier and more recent work exploring the character of L2 age effects, the evidence for a critical period, and the role of factors other than age in L2 ultimate attainment. The first section situates the critical period debate in terms of maturation and experience, contrasting categorical critical period approaches (e.g. Bley-Vroman 1990; DeKeyser 2000) with more relativistic ones (e.g. Singleton and Ryan 2004; Herschensohn 2009). The second section presents evidence for AoA effects in phonology, grammar and processing in child and adult learners of L2, while the third section discusses intersecting factors such as literacy, motivation, social identity and first language influence.

### 15.2 Critical periods, maturation and experience

Lenneberg’s (1967) influential arguments for the biological foundations of human language grew out of earlier work by Penfield and Roberts (1959) on language, and by a range of biologists on critical periods (e.g. Lorenz 1978 [1937]; Gray 1978 [1958]; Hubel and Wiesel 1965). For example, Hubel and Weisel patched one eye of a young kitten during the period of hypothesized binocularity formation; the kitten – deprived of the visual stimulation in one eye – was never able to develop depth perception. A strict definition of a biological critical period involves a developing organic system that is genetically scheduled to respond to a maturational event (e.g. visual response to stimulation for vision or a shift in hormones at puberty) at the onset of a critical period, and reaches its terminus when the development is complete (cf. Bornstein 1987a, b). If the process is interrupted, it may result in incomplete or failed development of the organ in question, as in Hubel and Wiesel’s eye-patched kitten which ultimately failed to develop depth perception. The evidence for a developmental schedule for L1A may appear compelling (Lenneberg 1967; Guasti 2002), but the same question for L2A is more complex and has been a subject of debate, leading most scholars to agree that the broader term sensitive period (Knudsen 2004; Bialystock and Hakuta 1999; Flege 1999) is preferable since it implies softer boundaries. For L2A, prior experience with a native language affects learning of subsequent languages (Flege and Liu 2001; Birdsong 2005a, 2006a; see also Chapter 5, this volume), and a number of non-linguistic factors outlined below can impact L2A as well. This section discusses two approaches to AoA effects in L2 learners, those advocating a categorical difference between adult and child L2A (Bley-Vroman 1990; DeKeyser 2000), and those supporting a more gradient difference (Singleton and Ryan 2004; Montrul 2008; Herschensohn 2009), thus setting the themes that will be examined in subsequent sections.

#### 15.2.1 A categorical critical period for L2

This section looks at the evidence for a sensitive period (rather than a critical period) for language acquisition and what its dimensions might be. The
Evidence for a critical period for first language acquisition (L1A) includes its predictable and relatively short schedule crosslinguistically, its inevitability even in cases of disruption such as left hemisphere brain lesions and its dissociation from other cognitive functions (Lenneberg 1967; Guasti 2002; Herschensohn 2007). In addition, there is a marked decline in grammatical processing and automaticity in cases of L1 deprivation (Curtiss 1977; Newport 1994 [1990]) relating insufficient input to insufficient brain development. In L1A, the infant’s brain uses linguistic input to forge new synaptic pathways and to prune others, resulting in implicit knowledge that will permit very rapid speed of native language processing in adulthood (M. Paradis 2004, 2009). Late L1 learners (most often deaf children with delayed onset of sign language) provide evidence for age effects (e.g. morphosyntactic deficits) in L1 attainment: Newport (1994 [1990]) finds an inverse correlation between morphosyntactic accuracy and AoA in L1 learners of sign language whose onset age ranged between 4 and 12 years. Research on deaf sign language learners whose first exposure was beyond age 12 is scarce and anecdotal (Curtiss 1988; Schaller 1995), but it is clear that L1A of morphosyntax is significantly incomplete (Newport cites only 50 percent accuracy of those with AoA greater than twelve years on grammaticality judgment or GJ tasks). Curtiss and Schaller document two case studies of language-less deaf individuals, Chelsea and Ildefonso, who only achieve modest gains in vocabulary after beginning acquisition as adults (see Herschensohn 2007 for more detailed discussion of L1A by deaf and so-called feral children who received no language input during childhood). Using gross measures of grammatical mastery, one could designate 0–4 years as the “very sensitive” period (the cutoff for native attainment according to Meisel 2008), and 5–10 as the offset for L1A of morphosyntax. For the native language, acquisition of implicit phonological and morphosyntactic knowledge, including very rapid online processing, is best accomplished with a very early start, at birth (Herschensohn 2007).

The evidence for a sensitive period for L2A is less clear, robust and definitive. Infants exposed to sufficient input in two languages learn both with native ability in a pattern and time frame similar to that of monolinguals (Bialystok 2001; Meisel 2004, 2008; Genesee, Paradis and Graco 2004). With sufficient continuing input, social interaction and the facilitation of literacy (Montrul 2008), they can become balanced bilingual adults. However, when these ideal conditions are not met, bilinguals favor a dominant language (the mother tongue or the subsequent one) and may have incomplete command of the other language (see Chapter 17, volume).

On a categorical view, single cases of purported competence might serve to provide support against a critical period: “a single learner who began learning after the period closed and yet whose underlying linguistic knowledge (not just performance on a limited production) was shown to be indistinguishable from that of a monolingual native speaker would serve to refute the claim [of a critical period]” (Long 1990: 255). Scholars on both sides of the debate have adduced evidence to maintain the view that older (post-puberty)
learners can achieve competence (as measured by linguistic metrics) within the native range (e.g. Ioup, Boustagui, El Tigi and Moselle 1994; Bongaerts 1999; Obler and Gjelroy 1999) or that they cannot (e.g. DeKeyser 2000; Hyltenstam and Abrahamsson 2000).

High achievers aside, L2 learners generally show declining ability with increasing AoA, an indisputable tendency that many scholars seize to claim a critical period as a given of post-puberty L2A (DeKeyser and Larson-Hall 2005). For example, proponents of an L2 morphosyntactic deficit (e.g. Hawkins and Franceschina 2004; Hawkins and Casillas 2007) or of the Interpretability Hypothesis (e.g. Tsimpli and Dimitrakopoulou 2007) argue that morphosyntactic features (e.g. gender, tense) non-existent in L1 are unavailable or problematic: “uninterpretable [grammatical] features are difficult to identify and analyze in the L2 input due to persistent, maturationally-based, L1 effects on adult L2 grammars” (Tsimpli and Dimitrakopoulou 2007: 217; cf. Birdsong 2009a).

Scovel (1988) argues that the sensitive period applies to speech production (pronunciation) and perception, essentially sparing morphosyntax. Johnson and Newport (1989) and many replications of their study (Bialystok and Hakuta 1994; Birdsong and Molis 2001; Jia and Aaronson 2003) indicate morphosyntactic decline inversely correlated to AoA. Diminished processing speed, as well as accuracy, also characterize the decline of the sensitive period offset (Guillemon and Grosjean 2001; Clausten and Felser 2006a, b).

There is, however, no empirical corroboration for a single definitive age of terminus for a critical period since research shows that different subdomains of language are affected at different ages (Seliger 1978; Moyer 2004; Abrahamsson and Hyltenstam 2008, 2009). Furthermore, true critical periods are strictly biological and linked to maturation, whereas L2A is impacted by a range of non-biological factors (Birdsong 1999a; Moyer 2004). Finally, the distinct roles of maturation and experience in L2A cannot be separated, and some scholars maintain that the latter – exposure to the TL – is more important than the former (Flege and Liu 2001).

### 15.2.2 Age effects from a gradient perspective

In contrast to the view that there is a categorical divide between pre- and post-critical period L2 learners, a more gradient view of age effects in L2A takes into account a number of factors (see Singleton and Ryan 2004; Herschensohn 2007, 2009; Dörnyei 2009a). Evidence cited above indicates there is a maturationally sensitive period for L2A, with offset decline beginning at age 4, and steeper decline occurring through the teen years, but with no definitive terminus (Herschensohn 2007). There is no strictly delimited biological critical period (definitive onset, offset and terminus) for acquisition of L2 grammar (phonology, morphosyntax, semantics): “no study has as yet provided convincing evidence for the claim that second language speech will automatically be accent-free if it is learned before the age of about six years and that it will definitely be foreign-accented if learned after
puberty” (Piske, Mackay and Flege 2001). Adult L2 learners resemble child and teenage L2 learners in endstate competence in many respects; differences are often quantitative, not qualitative. For example, late bilinguals, even very proficient ones, show lower grammatical accuracy and slower but not a different sort of processing (longer reaction time) than native speakers and early bilinguals, given standardized proficiency measures such as those used in experimental tests (Hyltenstam and Abrahamsson 2000, 2003).

Adult and child learners – rather than showing categorical distinctions in the process of acquisition – share a number of patterns in L2A. An obvious shift in cognitive functions of the maturing individual includes a reduction of implicit learning and an increase in explicit learning with age (M. Paradis 2009), but this shift cannot singularly explain age effects. Contrasting adult and child L2A under the same circumstances reveals both similarities and differences in path and ultimate achievement (Schwartz 1992, 2003). For example, Unsworth finds that for both stylistic movement of direct objects (2005) and gender agreement with determiners (2008a) in L2 Dutch, children and adult learners perform alike, indicating, she argues, comparable acquisition patterns and competence.

The next section examines similarities and differences between native speakers and L2 learners in terms of their grammars (phonology, morphosyntax), the lexicon and processing.

### 15.3 Ultimate attainment in L2A

The terms endstate and ultimate attainment in L2A refer to a putative stage after which there is very little change in L2 competence; this state or stage may represent a highly incomplete grammar (due to inadequate input, instruction, motivation, etc.) or a highly proficient level of achievement (see Chapter 31, this volume). This stage has been characterized as one of fossilization or stabilization (Long 2003). Studies of age effects ideally look at individuals who have stabilized after receiving adequate input under optimal conditions; they do not look at individuals who are fossilized with a highly incomplete grammar or are at an intermediate stage of acquisition. The benchmark for most age-related studies (criticized by Bley-Vroman 1983 as the comparative fallacy) usually has been native-level achievement. Native speakers are essentially at ceiling on both speed of processing and accuracy (under normal, not stressed circumstances). As this section documents, L2 learners show decreasing proficiency with increasing AoA in all areas of linguistic competence, phonology, morphosyntax, lexicon and processing.

#### 15.3.1 Phonology

Beginning with Asher and Garcia’s (1982 [1969]) investigation of Cuban Americans with varied AoAs, a number of studies in the ensuing decades tested
native speakers’ perceptions of adult immigrants’ nativeness in their L2 pronunciation as perceived by native listeners (Scovel 1988; Moyer 1999; Flege et al. 1999; Piske et al. 2001) or in their perception of L2 speech (Oyama 1978, 1982; Bradlow et al. 1995; Yamada 1995; Flege and Liu 2001; Flege and MacKay 2004; Lekiu, Raphiq, Zohar and Shimon 2009). In his comprehensive work on immigrants with a range of AoAs, Scovel (1988) found that native speakers’ perception of non-native speakers’ phonology was far more accurate than their perception of non-native morphosyntax. In reference to the Polish writer, he terms this the Joseph Conrad effect: L2 learners with higher AoAs were perceived as possessing a less nativelike accent than those with lower AoAs. In written production, however, learners of various AoAs were perceived as nativelike in morphosyntactic accuracy, leading him to claim that phonology but not syntax was susceptible to a critical period.

More extensive and carefully controlled studies of immigrant learners (Moyer 2004, English L1, German L2; Abrahamsson and Hyltenstam 2009, Spanish L1, Swedish L2) support the role of AoA in L2 phonological mastery. Moyer’s (2004) investigation of twenty-five anglophone L2 German learners (AoA mean 12 years) in terms of four production tasks (word list, paragraph, spontaneous speech, proverbs) revealed “phonetic, suprasegmental, lexical and syntactic fluency” (2004: 69). The speakers were then judged by native speakers of German whose rankings of nativeness were statistically evaluated in terms of thirty-five non-linguistic factors the speakers had reported in a questionnaire (e.g. AoA, motivation, instruction, frequency of usage). AoA and length of residency (LoR) were by far the most significant of the factors, while aspects such as motivation or professional need had little influence on the subjects’ fluency as perceived by native Germans. Moyer concludes (2004: 93) “while age of onset may exert independent influence on attainment, it does not provide a satisfactory explanation for non-native outcomes in SLA.” Although physiological maturation plays an important role in phonological mastery, Moyer finds that factors related to social integration, cultural identity, or education are also important to the L2A of phonology.

Abrahamsson and Hyltenstam (2008, 2009) – extending their already well-established research in age effects – investigate age effects in a group of highly proficient L2 Swedish learners (LoR ten years+) whose L1 is Spanish and who have varying AoA. The first criterion is for the subjects to be perceived as nativelike by native speakers of Swedish, a selection accomplished through the familiar use of native-speaker perceived ranking. For the study, 195 volunteer advanced Swedish learners and 20 natives were recorded in telephone interviews. The Swedish native-speaker judges listened to 20–30 second snippets of the recording and then rated these as mother tongue or not, giving a perceived nativeness (PN) score of 1–10. Native controls scored 9.9, early learners (<11 years) 7.9, and late learners (>12 years) 2.5. A more detailed age breakdown shows a clear decline of PN with increasing AoA. The authors subsequently conducted a series of tests on learners whose PN was 6+ from early and late learner groups. They administered ten cognitively
challenging tasks (going beyond the type of test hitherto used for AoA such as a simple grammaticality judgment (GJ) task or native perception of accent), four of which involved phonological production and perception of voice onset time (VOT) and perception in babbling and white noise environments. In scrutinized nativeness (SN, the more stringent criteria represented by the challenging tasks), the authors found “a significant difference in mean SN scores between the early and late learners” (2009: 281). While the early learners outperformed the late ones on all tests, the difference was most dramatic (nearly double the achievement level) for the VOT tests and babble perception. These carefully conducted experiments clearly show the importance of age to the acquisition of the L2 sound system, both in perception and production.

In contrast, recent studies with instructed groups of learners (Muñoz 2006a, 2008a, b; Larson-Hall 2008) offer little support for an age advantage in learning L2 phonology. Larson-Hall (2008: 53), who tested 200 early (AoA mean 8.3 years) and late (AoA mean 12.5 years) Japanese learners of L2 English, found a “statistical difference between the groups for the phonemic discrimination task,” [l] vs. [w], which she nonetheless characterizes as modest. She infers a number of non-linguistic factors such as aptitude, motivation and amount of input, rather than maturation, to be influences on this outcome. Muñoz reports on the Barcelona Age Factor (BAF) project (1995–2004) which collected data from four groups of Spanish-Catalan learners who began instruction in L2 English at different AoAs (8, 11, 14, 18+), and who were all tested after 200, 416 and 726 hours of instruction, respectively. The project is informative in covering a large population (hundreds of subjects) and in giving a long-term longitudinal perspective (nearly a decade). However, the project points up differences between naturalistic and instructed L2A (especially with child learners), the latter sharing more traits with instruction in other academic topics than with naturalistic learning. In the introductory chapter Muñoz furnishes a very informative discussion on the history of investigation of (non-)benefits of early instructed exposure, including work by Snow and Hoefnagel-Höhle (1978). Unlike naturalistic exposure, instructed exposure to an L2 does not show a clear advantage for earlier learners; there is often an advantage for higher AoA, for the older learners have more developed cognitive skills and academic strategies that furnish an advantage in instructed language learning (as any other academic topic). Furthermore, as Fullana (2006) points out, formal instruction provides a fraction of the input of full-time immersion (and see Moyer 2004 above). Fullana describes the BAF learners’ performance on phonetic perception and production tasks, noting that the younger learners generally do not show a great advantage. At Time 1 (200 hours) on the phonetic discrimination task, the older learner groups for all AoAs showed higher scores, but by Time 3 (726 hours) the youngest learners (AoA age 8) caught up and then surpassed all other groups. For production, in contrast, AoA was not significant for perceived accent scores, although most judges tended to rate AoA age 8 learners
as more foreign-accented than AoA age 11. Closer examination of production of distinct vowels (e.g. \[a\] vs. \[i\]) revealed variability in pronunciation for all age groups. Other aspects of English that were examined in this overall study show clear advantages to the older learners in an academic setting, although phonological mastery is an area where there does seem to be some advantage to early learning.

Since for the BAF phonetic perception was the only area in which lower AoA seemed significant, the view that phonology is more susceptible to age effects than other linguistic domains may be supported. There are, nevertheless, high-achieving adult L2 learners in other studies who are perceived by native judges to have native phonology (Neufeld 1980; Moyer 2004; Bongaerts 1999; Bongaerts, Planken and Schils 1995, 1997). For example, of the twenty-five near-native adult L2 German learners in Moyer’s (2004: 71) investigation of factors contributing to perceived proficiency, nine fell into the native range. Likewise, Bongaerts (1999) and colleagues (Bongaerts et al. 1995, 1997) have demonstrated perceived nativeness in adult AoA Dutch learners of L2 French and L2 English. All of the highly successful Dutch learners of L2 English in the 1995 study were rated as native on several criteria by native anglophones. Although L2 phonology is one of the most elusive linguistic domains for adult L2 learners to master, the foreign accent criterion should not be the only one used in evaluating nativeness, a topic discussed below.

15.3.2 Morphosyntax

Morphosyntactic non-nativeness is less obvious to native perceivers than foreign accent (Scovel 1988), yet a wealth of literature has documented adult L2 morphosyntactic deficits and declining grammatical proficiency with increasing AoA. Following up on Patkowski’s (1982) study of immigrants, Johnson and Newport (1989) established a battery of 276 GJ sentences that were either correct or grammatically flawed. Administered to forty-six immigrants (Chinese or Korean L1, AoA ranging 3–39 years), the results showed that the earliest AoA subjects clustered within native-speaker scores (around 270), whereas the late learners (AoA 17+) showed significantly lower scores (210 and below). The methodology and conclusions of the authors have been questioned (e.g. Bialystok and Hakuta 1994, 1999; Birdsong and Molis 2001), but the test has been replicated by numerous scholars, always supporting the inverse correlation of AoA and nativelike morphosyntactic judgment (e.g. DeKeyser 2000; Birdsong and Molis 2001; Jia and Aaronson 2003). Birdsong and Molis’ results highlight the importance of L1 influence, for their subjects, who were Spanish L1 speakers, scored generally much higher than Johnson and Newport’s, and had higher scores with later AoAs (see also Chapter 5, this volume). DeKeyser (2000) elucidated the advantage for L2A of high verbal aptitude, a trait of individual learners whose influence on ultimate attainment has been corroborated in L2 Swedish by Abrahamsson and Hyltenstam (2008).
The two large studies examined in the previous section on naturalistic L2 Swedish (Abrahamsson and Hyltenstam 2009) and instructed L2 English (Muñoz 2006a) provide similar results in morphosyntactic competence to those in phonology. Recall that the Swedish study administered the final battery of tests only with learners whose L2 speech was deemed nativelike by Swedish judges. The subjects were given GJ tasks in both auditory and written contexts, and their reaction times were also measured. The scores of the early AoA 1–11 and late AoA 13+ (LoR ten years+) learners differed significantly: for accuracy of auditory GJ, 58 percent early to 40 percent late, and of written GJ 65 percent early to 50 percent late (the numbers indicate percentages of subjects within the range of native Swedes). The authors chose this grouping “because these may be thought of as representing L2 learning before and after the closure of a critical period” (2009, 262). For reaction times, early learners were 94 percent within native range, whereas late learners were only 60 percent. The results corroborate earlier findings concerning the inverse relation of increasing AoA with morphosyntactic nativeness, and thus the difference between early and late learners, even very good ones. The results also underscore the apparent biological foundation of speech – the real-time implementation of perception, production, comprehension and judgment. What the authors emphasize, however, is not how well the child learners performed (which they indeed did, essentially passing for native with suedophones), but rather that they did not perform at the ceiling level of the native Swedes. They conclude “that nativelike L2 proficiency is, in principle, never attained by adult learners” (2009: 289), and “that one may consider it a myth that L2 learning that begins in childhood easily, automatically and inevitably results in nativelikeness” (2009: 290).

In stark contrast to these naturalistic learners whose abundant input and often early exposure to the L2 resulted in near-nativeness (despite not being at ceiling), the instructed learners described in the Muñoz collection (e.g. Fullana 2006; Mora 2006; Muñoz 2006b, c) did not show an advantage for younger age. “The descriptive data show that the late starters [AoA 11 years] always obtained higher scores than the early learners [AoA 8 years]” (Muñoz 2006b: 24). Furthermore, the slight advantage that the early learners eventually had for phonology in the long run was not paralleled by a long-term catch-up in morphosyntax, narration and other domains, where the higher AoA learners showed higher scores at every testing time. Mora (2006), who analyzes an oral narrative of a cartoon for fluency development, uses criteria such as speech rate in words and syllables, L1 word ratio, mean length of sentence, dysfluency and pauses. These measures, while a gauge of perceived fluency, also reveal the learners’ ability to engage lexical retrieval, morphology, syntax and discourse constraints in real-time implementation of the grammar. She concludes that the L2 learners are far less fluent than the native controls and that “late learners outperform early learners on the basis of their faster speech rate, much lower restricted use of L1 words and the use of longer fluent runs” (2006: 84). The BAF studies underline the
difficulties of evaluating age effects in learners who are not endstate, since when studied these instructed students were far from stabilized in their knowledge and practice of L2 English.

Torres, Navés, Celaya and Pérez-Vidal (2006) find similar results from the BAF corpus in their analysis of writing ability as shown through compositions that were judged on fluency (essentially quantity), lexical complexity (breadth of vocabulary), grammatical complexity (complex sentences) and accuracy. As with Mora’s analysis of oral narration fluency, for the four writing criteria the older learners (AoA 11) outperformed the younger ones in a statistically significant manner for 15/17 of the subcriteria. Unsurprisingly, amount of instruction time correlated positively with improved scores in all areas, and generally the older learners outperformed the younger ones at the same level of instructional hours. However, the younger group, while still showing lower scores at Time 3 (726 hours of instruction), was no longer systematically inferior to the older group. Once again, it appears that a sufficient quantity of input coupled with advancing skills in explicit learning may help the younger learners.

These analyses and the others reported from the BAF project provide ample evidence for the age advantage in instructed foreign language learning; in such environments, older learners are more adept at using explicit learning strategies, while younger learners make more use of implicit learning (M. Paradis 2004, 2009; DeKeyser 2003; DeKeyser and Larson-Hall 2005). This research provides extensive evidence corroborating the age advantage for older learners in initial stages that had been observed in earlier studies (Snow and Hoefnagel-Höhle 1978, 1982 a, b), but it also clearly shows the necessity of sufficient input to the development of a broad range of L2 skills (Piske and Young-Scholten 2009). With sufficient input, as in a naturalistic setting, children are much better eventually at L2A than adults, but the disadvantage that older learners have in implicit acquisition is partially compensated for by their advantage in explicit learning. In this sense, they are able to take advantage of an instructional setting to bootstrap the L2. Another observation that emerges from the BAF studies is the independence and interdependence of various aspects of L2A. The distinct developmental patterns of phonology as opposed to morphosyntax have long been recognized (Seliger 1978), and the BAF studies show additional distinctions and differing trajectories for other areas such as narration or composition as well.

15.3.3 Processing and lexical access

In addition to ceiling performance in phonology and morphosyntax, native speakers enjoy automatized and rapid speech (see Chapter 6, this volume, for discussion); child L2 learners often share these processing advantages (Clahsen and Felser 2006a, b). In contrast, adult L2 learners are far less accurate and quick in morphosyntactic processing, although lexico-semantic
knowledge is fairly comparable for native and second languages (Osterhout, McLaughlin, Kim, Greenwald and Inoue 2004; Hopp 2007; Tanner 2011). The distinction is not surprising in that lexical learning goes on throughout the lifetime in any language, and depth of lexical knowledge correlates with a number of non-grammatical factors such as frequency, neighborhood density (similarity to other words), word length and sociopragmatics for both L1 and L2 (Hirsch, Morrison, Gaset and Carnicer 2003; Kutas and Schmidt 2003; Silverberg and Samuel 2004). It is then instructive to compare L2 learners’ real-time processing of speech with that of native speakers to determine that they show the same basic division and are sensitive to the same external factors, and furthermore to ascertain which areas are most influenced by AoA (Frenck-Mestre 2005a; Grosjean 2004).

This section briefly looks at evidence from two sorts of psycholinguistic studies, behavioral and electrophysiological (see Chapters 19 and 20, this volume). Behavioral studies infer mental procedures from physiological responses to baseline events compared to various sorts of experimental task responses (linguistic, in the case at hand). Common techniques include measuring reaction time (RT) to a facilitating or inhibiting trigger compared to the baseline, or examining eye movements in a reading task (Frenck-Mestre 2005b; Siyambalapitiya, Chenery and Copland 2009). Longer RT or rereading can reveal that a given task requires more cognitive effort to process, resulting in slower or more laborious behavior that is less automatized (hence less speedy). For example, for native speakers of English sentences with verb disagreement – such as the key to the cabinets were rusty – require longer RTs than grammatical ones (Tanner 2011). Tanner examines perceptual responses in native and L2 English to this type of ungrammatical sentence (an agreement attraction error, with the plural attractor noun cabinets next to the plural verb) that is frequently observed in native English production.

Electrophysiological studies track the time course of the electrical pulses that constitute activation of neural networks in the brain (Osterhout et al. 2004; Osterhout, McLaughlin, Pitkänen, Frenck-Mestre and Molinaro 2006). Electroencephalography (EEG) portrays a graph of negative and positive activity recorded at a given site on the scalp, where a gel-coated electrode picks up signals through the skull. Typical responses to a sentence such as I drink beer can be compared to experimental atypical responses, particularly with respect to lexico-semantic and morphosyntactic anomalies that have been observed through these event-related potentials, or ERPs. For monolinguals, the EEG for a semantically anomalous word in a sentence such as books in I drink books results in a negative wave produced 400 ms after the word (N400). In contrast, the response to a morphologically anomalous word such as drinks in I drinks beer is a positive wave about 600 ms after the word (P600). The N400 and P600 have been well documented crosslinguistically and with a range of anomalies that belong to these two classes: lexico-semantic (e.g. wrong words, non-words) or morphosyntactic (e.g. verb disagreement, gender mismatch).
Osterhout and colleagues (2004, 2006, 2008), in longitudinal ERP studies with beginning French L2 learners during their first year of instruction, found L2 responses similar to those of monolinguals. The L2 learners registered an N400 response to lexical anomalies (non-words) after only 14 hours of instruction, but their explicit conscious judgments of whether an item is a word or non-word were at chance. On selected grammatical phenomena (e.g. verb agreement), the learners developed an N400 response after five months of study, a response that indicates a lexi-cosemantic anomaly for monolinguals. However, by the eighth month of the year, the L2 learners responded to the grammatical anomaly with a P600 (as do native speakers), a development that the researchers attribute to the grammaticalization of verb agreement in the L2. The ERP responses have been documented for advanced L2 learners as well. For example, in a study of verb agreement/disagreement in very proficient native Spanish learners of L2 English, Tanner (2011) found that the L2 learners demonstrated ERP responses that are qualitatively similar to native responses by English speakers, not only in terms of the overall pattern (P-600 / N-400), but also with respect to non-linguistic factors such as the presence of an attractor plural noun next to the verb (key to the cabinets was/were). For natives and L2 learners lexi-cosemantic processing shows greater similarity than does morphosyntactic processing, but the two categories are not mutually exclusive (Frenck-Mestre 2005a; Grosjean 2004).

Lexical access – the ability to retrieve a word’s meaning instantaneously – might appear to be a lexi-cosemantic phenomenon. However, the morphosyntactic correlates of a word also impinge on its retrieval. For example, languages with noun gender indicated by grammatical concord on a prenominal determiner give a prelexical cue to a noun’s gender and lead to a shorter RT in lexical access to identify the word. Native speakers demonstrate congruency/incongruency effects by showing faster recognition of nouns with congruent (agreeing) than with incongruent gender marking on determiners and adjectives (for Spanish and French, see Antón-Méndez, Nicol and Garrett 2002; Grosjean, Dammergues, Cornu, Guillelmon and Besson 1994). Hence the seemingly redundant nature of gender concord actually bootstraps lexical processing. For L2 learners, Guillelmon and Grosjean’s (2001) auditory word repetition task reveals that natives and early (AoA 5 years) but not late (AoA 24 years) English–French bilinguals demonstrate congruency/ incongruency effects similar to monolinguals (Grosjean et al. 1994). These data suggest that early L2 learners behave more like natives than do their late counterparts, a finding that has been repeated in other studies (cf. Clahsen and Felser 2006a, b). However, this facilitation is mitigated by various other variables, especially proficiency level, which is overall a better diagnostic than simple AoA (Perani and Abutalebi 2005).

Although adult L2 learners show quantitative differences from early bilinguals and monolinguals in RT, and at initial stages show little sensitivity to factors natives take into account (e.g. verb disagreement), they can eventually gain qualitative patterns that resemble those of native processing. Foucart
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(2008) and Sagarra and Herschensohn (2010, 2011) examine gender processing in L2 French and Spanish, respectively. Foucart uses eye movement and event-related potentials (ERPs) in comprehension and production tasks with L1 English, German and Spanish learners of L2 French to compare their processing of concord and discord with that of French natives. She finds that despite quantitative differences (L2 learners have slower RTs, and L1 influences speed of processing as well; cf. Sabourin, Stowe and de Haan 2006), the learners show qualitative similarities to monolinguals (P-600 response to gender disagreement). She concludes that gender representation is similar for both late bilinguals (i.e. older L2 learners) and natives (whether or not the L1 is gendered), but that gender computation is less automatic in the L2 than in the L1. She underscores the idea that highly proficient bilinguals may reach nativelike representation and processing of gender, regardless of AoA or L1 influence.

Sagarra and Herschensohn (2010, 2011) examined beginning (first-year university students) and intermediate (third-year students) adult anglophone learners of Spanish in online (RT) and offline (GJ) tasks on sentences with noun–adjective gender/number agreement/disagreement. Results indicate that all participants were highly accurate in the (self-paced) offline task, but that only intermediates and Spanish native controls showed sensitivity to gender and number violations in the online task for the 2010 study. Their 2011 study shows similar results, with intermediates and monolinguals demonstrating sensitivity to concord/discord and to animate versus inanimate nouns. Intermediates and Spanish monolinguals have longer reading times in sentences with gender discord than in sentences with concord, and in those with animate rather than inanimate nouns. These results suggest that intermediate learners display targetlike patterns that are more qualitatively similar to those of natives than do beginners. The overall findings suggest that adult learners can develop processing patterns qualitatively similar to those of native speakers.

Clahsen and Felser (2006a) compared the processing of adult L2 learners with that of native children and adults and explained similar strategies for children and adult natives as examples of continuity, although native children have slower RTs than native adults. In contrast, they argue that L2 processing of complex syntax (e.g. relative clauses) remains non-nativelike, a difference they attribute to the learners’ preference for lexico-semantic or linear information (termed shallow structure parsing) over nativelike full parsing that makes use of non-linear structural relationships for phrase structure and filler–gap dependencies. The divide is not categorical, though, since native speakers use both shallow and full parsing, and extremely proficient late bilinguals (older L2 learners) may, in principle, use full parsing as well as shallow. In contrast, Hopp (2007) attributes differences between native and L2 processing to factors such as L1 influence or computational limitations. In German, scrambling (the movement of verbal arguments) is a stylistically complex construction that is sensitive to a number of semantic
and morphological features. Hopp investigated scrambling in L2 German by late bilinguals (L1 Dutch, English, or Russian) in offline and online tasks. He argues that the results reveal L2 morphosyntactic control as well as interpretation and processing strategies that resemble those of natives. The open questions of how similar natives and non-natives are will be further explored in the next section.

15.4 Influences on L2A

The ample evidence presented in the preceding section on age effects in grammatical competence, foreign accent and speed of processing shows clearly that there is a sensitive period for learning a second language: earlier is better. The evidence also indicates that this period does not include a threshold set at a specific age after which L2A is impossible, as a true biological critical period would. The categorical view of a critical period does not hold, but the exact nature of the L2 sensitive period and its underlying causes require further investigation here. Clahsen and Felser (2006b), in discussing non-native processing, describe four factors distinguishing L2 from native processing: variable levels of grammar knowledge (proficiency), L1 influence, cognitive resource limitations and maturation, all of which contribute to L2 variability and incompleteness. The last three factors are not limited to processing, but can be seen in other areas of L2 competence and furnish the themes for this section.

15.4.1 Maturation and the brain

The importance of AoA points to maturation as an important factor for mastery of a second language. The early establishment of neural networks for L1 phonology figures importantly in later restrictions on the brain’s ability to gain L2 phonology (Kuhl 1991, 2004; de Boysson-Bardies 1999). Kuhl (2004: 831) points out that “infants are ‘primed’ to learn the regularities of linguistic input when engaged in social exchanges,” and that they are sensitive to two main phenomena during the first year of life, prosody and distributional frequencies of the sounds of the ambient language. Armed with a predisposition to learn language by segmenting the stream of speech (Guasti 2002; Jusczyk 1997), they hone perception skills whose potential phonemic categories and statistical generalizations (e.g. the ability to recognize segmental sequences, syllables and eventually words) are later used to shape their production of first words, phrases and eventually sentences. The early establishment of neural networks in the brain supporting linguistic development indicates that phonology is one of the first acquired abilities, one which is the most difficult to overcome when trying to gain a new L2 phonology in later life. Kuhl points out that experience and maturation are interdependent, and that “neural commitment to the statistical and prosodic regularities of one’s native language promotes the future use of these learned patterns in
higher-order native-language computations [and . . .] interferes with the processing of foreign-language patterns that do not conform to those already learned” (2004: 838).

Many scholars see a categorical difference in the learning patterns, implicit versus explicit, that characterize child and adult skill development. The learning that occurs as neural networks are established by the infant is obviously unconscious and implicit. The contrast between this implicit learning of procedural routines can be contrasted with the typical explicit learning patterns of adults gaining declarative knowledge in a range of domains in addition to language. Explicit learning patterns result in declarative knowledge for those (overwhelmingly instructed) adult learners studied thus far (see Chapter 6, this volume). In L1A the maturing brain develops its dedicated linguistic areas, especially in the left frontal and temporal lobes, while also connecting to other regions in the right hemisphere and subcortex (Schumann et al. 2004). Just as Lenneberg cited automatic acquisition from mere exposure as a characteristic of L1A, other scholars cite implicit learning as the defining property of L2 learning in childhood (DeKeyser 2000, 2003; Ullman 2001b; M. Paradis 2004, 2009), contrasting it with the explicit learning of adults (for both naturalistic and instructed environments). DeKeyser (2000) further demonstrates that for individual learners, higher verbal analytical skills (better explicit learning techniques) contribute to greater ultimate achievement in adult L2A. Ullman links the two means of learning and memory to different brain areas: declarative in the medial temporal lobe and procedural in the left frontal lobe and basal ganglia. Implicitly learned procedural patterns are established early in life, whereas explicit learning becomes more important with increasing age. M. Paradis (2004) agrees that late L2 learners rely on explicit learning, resulting in “a cognitive system different from that which supports the native language” (59). M. Paradis (2009) places even more emphasis on the differences between the two learning mechanisms and memory types, essentially excluding procedural language learning by adults. He recognizes that very fluent L2 adults may appear to have cognitive systems similar to natives, but he proposes (without testing) that they may simply have speeded up processing due to extensive practice. Paradis’ view is not accepted universally, since many psycholinguists argue that L2 learners have qualitatively similar grammatical representation and processing to native speakers (e.g. Osterhout and colleagues; Foucart 2008; Hopp 2007; Tanner 2011; see also Chapter 7, this volume, on what cannot be learned explicitly, yet is nonetheless acquired).

Despite the obvious advantage imparted by early establishment of linguistic neural networks through implicit learning, the categorical version of implicit learning as the sole factor in age effects requires mitigation. Some learners become proficient and implement procedural storage of L2 grammar, as indicated by psycholinguistic studies, leading Ullman (2001b: 110) to say that “practice as well as age of exposure should affect both grammatical proficiency and the degree of dependence on procedural memory for grammatical computations.” The abilities of proficient late bilinguals/older
L2 learners who exhibit procedural mastery in the L2 (Hopp 2007), the qualitative similarity of L1 and L2 processing (Perani and Abutalebi 2005), the fact that even intermediate learners show evidence of implicit learning (Sagarra and Herschensohn 2010) require a more nuanced version of the implicit/explicit divide. Perani and Abutalebi (2005: 205) note that in L2 processing, “the patterns of brain activation associated with tasks that engage specific aspects of linguistic processing are remarkably consistent among different languages, which share the same brain language system.” Dörnyei (2009a: 257) points out that implicit proceduralization plays an important role in adult L2A, a tendency not predicted by restricting adults to explicit learning alone. Indeed, the distinction between declarative and procedural ability can be illustrated by the contrast between instructed learners who know declarative grammar rules but don’t yet have procedural abilities. Sagarra and Herschensohn’s (2010, 2011) beginners – who had clearly documented declarative knowledge of adjective agreement in Spanish in the grammar test, yet lacked sensitivity to adjective discord in the online task – contrasted with the intermediates who showed both declarative and procedural abilities that were qualitatively similar to those of monolingual Spanish speakers.

The question of whether neural commitment in early learning through implicit acquisition is definitively completed in childhood (as in a critical period threshold) is weighted toward childhood, but not categorically so. Adult L2 learners also demonstrate procedural learning and implicit knowledge of which they may be consciously unaware. For example, Osterhout et al. (2004, 2006) document continuing brain plasticity in adult language learners who develop implicit sensitivity to lexical grammatical anomalies in the L2. Osterhout et al. (2008) describe an increase in gray matter density over five weeks of intensive Spanish (cf. Mechelli et al. 2004). Pallier (2007) and Pallier et al. (2003), who studied Korean adoptees who learned L2 French at various ages of childhood, found that the adoptees completely lose their L1 and replace it with L2 French as evidenced both by behavioral tests and neuroimaging. Pallier concludes that these experiments “argue against irreversible modifications occurring in the first ten years of life, either because of maturational constraints or as a byproduct of learning the L1” (2007: 164). The evidence for continuation of brain plasticity leading to implicit learning and procedural knowledge is compelling and indicates that plasticity, although greatly reduced in adults as compared to young children, is still available to mature brains. The maturation and continuing plasticity of the brain constitute one factor contributing to sensitive rather than critical period effects; the persistent influence of the native language is another factor to be examined next.

15.4.2 Influence of the native language
The influence of the mother tongue on acquisition of subsequent languages has long been recognized (Lado 1957), but recent research has revealed more
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subtle aspects of the role of the native language in L2A. In one vein, studies using the immigrant AoA paradigm have shown quite differential results depending on the native language. Experimental studies looking at specific grammar points (e.g. adjective gender concord) also have exposed different L2 competence related to different L1s.

Several studies replicating the Johnson and Newport (1989) GJ tests used L2 learners with different L1s (the 1989 study had Chinese and Korean as L1s). Birdsong and Molis’ (2001) results with L1 Spanish speakers differ substantially in raw scores (generally higher) and onset of decline (generally later) from the earlier study with East Asian L1 speakers. The two articles by Bialystok and Miller (1999), who looked at L1 Spanish and Chinese, and McDonald (2000), who looked at L1 Spanish and Vietnamese speakers, both showed higher achievement in L2 English by the Spanish speakers. As an Indo-European language, Spanish is distantly related to English, whereas the East Asian languages have no genetic relationship to English and are structurally quite different as well.

The influence of the native language is also a function of the learner’s AoA. For example, a reprise of the immigrant phonology study mentioned above is provided by Aoyama, Guion, Flege, Yamada and Adahane-Yamada (2008) who compared Japanese L1 adults (mean AoA 40) and children (mean AoA 10) longitudinally over a year (Time 1 and 2) on production and perceived accent of English L2 consonants. At Time 1 (.5 year), the adults outperformed the children, but by Time 2 (1.6 years) the children had definitively outpaced the adult learners, although they were not accent-free. The authors conclude that earlier is definitely better for L2A, but that early does not guarantee nativelike accent. The study is useful also in documenting the longitudinal progression of adults versus children that has been reported previously in more anecdotal terms. Dimroth (2008) likewise finds child/adult differences in acquisition of tense and negation in her case study of two Russian learners of L2 German (AoA 8, 14). Native language influence is partially determined by AoA.

Structural and morphological similarity also play a role in L1 influence. Sabourin and Stowe (2008) compared L1 Romance (French, Italian, Spanish) and German learners of L2 Dutch on ERP responses to verbal (inflection) and nominal (agreement of determiner and noun) anomalies, and they found a nativelike response to the former but not the latter by Romance speakers. Both conditions elicited a P600 for the German subjects, but only the verbal anomaly did so for the Romance subjects. They conclude (2008: 422) “the difference between L2 groups found in Experiment 2 suggests that in the case of gender, it is not sufficient to have gender in the L1, but that the systems must be very similar to that of the L1, down to the lexical level, in order for the processes eliciting the P600 effect to be employed in the L2.” Their results are similar to those of Sabourin et al. (2006), who measure gender concord in relative pronouns in L2 Dutch. They found chance accuracy in L1 English, better performance by L1 Romance and best performance by L1 German subjects. The genetic relationship of German and Dutch and their similar
morphology are cited as important factors for both studies (surface transfer), with abstract gender feature (deep transfer, as for Romance) as a secondary source of L1 facilitation. The relatively poor performance on Dutch gender as opposed to tense may in part be due to the very opaque gender concord system in Dutch that is not mastered by native Dutch children until the age of 7 (Blom, Polišenská and Unsworth 2008) and is quite related to lexical frequency (Unsworth 2008a). Hopp (2006), who looked at advanced and near-native learners, found no L1 related difference in his very proficient L2 learners of German whose L1 was either Dutch or English, but rather found that proficiency level was the most important factor in mastery of various aspects of subject–object ambiguities.

Gender agreement is also the topic of a Spanish–English study of two bilingual populations, heritage speakers (individuals whose mother tongue is a minority language that gives place to the social majority language in which they gain literacy) and adult Spanish L2 learners (Montrul, Foote and Perpiñán 2008), who differ in terms of AoA and input. Comparing the two groups (about 70 subjects each, 22 native controls) on two written comprehension tasks and one oral production task, the authors found that the adult learners outperformed the heritage learners in literacy tasks, while the heritage Spanish speakers were better on the oral task. In contrast to the error-free monolingual Spanish controls, both experimental groups made errors (10–25 percent overall), indicating incomplete grammars (cf. Montrul 2008; see also Chapter 17, this volume). The two populations – who differ in AoA, in amount of oral and written input, and in mode of acquisition – show no distinct advantage for earlier AoA and no consistent grammatical deficit for adult AoA. Contra advocates of critical period limits on grammar acquisition, the overall results point toward differences between the early and late learners that do not define a categorical critical period for language acquisition. If, however, the oral task is taken to be indicative of implicit knowledge (and the written one of metalinguistic explicit knowledge), the AoA advantage is clear. The authors conclude that “both L2 learners and heritage speakers know something about grammatical gender in Spanish, but such knowledge might be stored, represented and deployed differently” (2008: 542). The next section examines in greater detail how grammatical knowledge may be implemented.

15.4.3 Cognitive resources, experience and other variables

While brain plasticity and L1 transfer affect L2A, there are other factors – cognitive abilities, education, identity and input – that impact acquisition in additional ways. External influences such as literacy, education and amount of input are significant, as are individual characteristics such as verbal acuity and sociocultural identity. Moyer’s (2004) study underlines the less significant role of these additional factors compared to AoA, yet other research has
demonstrated measurable differences in acquisition ability due, for example, to cognitive aptitude and education.

Abrahamsson and Hyltenstam (2008) retested DeKeyser’s (2000) premise that verbal analytical ability facilitates L2A in their extensive study of perceived nativeness in Swedish L2 speakers. DeKeyser used an adaptation of the MLAT aptitude test while Abrahamsson and Hyltenstam adapted five sub-tests of the Swansea LAT (phonetic memory, lexical-morphological analysis, grammatical inferencing, aural memory and sound–symbol associations). DeKeyser found the predicted AoA advantage, with child learners outperforming adults, but with a mitigating effect: his L1 Hungarian learners of L2 English with high AoAs exhibited greater L2 accuracy correlated with their verbal analytical ability. Abrahamsson and Hyltenstam (2008, 2009) explore this cognitive advantage with a larger battery of tests, and they found that the advantage extended to childhood learners as well as adult learners. Comparing their Swedish learners to native speakers, they found that not only did the late learners benefit from higher language aptitude (confirming the DeKeyser thesis), but also the early learners: “a majority of those early learners who scored within the native-speaker range on the GJT [grammaticality judgment task] also had above average aptitude, and most of those who scored below the native-speaker range exhibited below-average aptitude” (Abrahamsson and Hyltenstam 2008: 499).

The interaction of individual cognitive skills with AoA and language processing is the topic of McDonald’s (2006) comparison of adult L2 English learners (L1 Spanish and Vietnamese) with native speakers. Assuming that working memory capacity and decoding ability could be important factors for language processing speed, she compared the L2 learners’ performance on word detection and GJ tasks with that of native monolinguals. Under normal circumstances, learners – as is well documented – process the L2 more slowly and less accurately (as indicated by the GJ task) than natives. However, under stress conditions of various types (e.g. added noise) the monolinguals likewise showed reduced speed and accuracy. Furthermore, the cognitive factors were significant for both L2 learners and natives: higher memory and decoding ability correlated with increased accuracy in GJs in both L2 learners and stressed native speakers. It is possible “that late L2 learners actually have a large overlap in grammatical knowledge with native speakers; they are just processing the sentences under difficult conditions, analogous to natives listening through noise, or maybe with an extremely high memory load” (McDonald 2006: 397).

Another important variable affecting age and acquisition is education, the compensatory nature of which can be seen in the explicit learning that L2 learners exploit, as evidenced in the BAF studies. Tomiyama (2008), who looks at attrition of L2 English by two Japanese siblings, concludes that the older one, whose L2 English was more solidly established at his departure from North America and remained more robust than that of the younger sibling, “spent more years in the educational setting providing him with more
opportunity to solidify his literacy skills” (2008: 271; see also Chapter 9, this volume). The educational advantage even carries through cross-modally (Prinz 1998), as greater cultivation of linguistic skills in American Sign Language (ASL) helps development of written L2 English. Prinz (1998) points out that continuing use of ASL in school (e.g. honing narrative skills, problem solving in ASL) is beneficial to developing literacy skills in L2 English, hence overall academic performance. Chamberlain and Mayberry (2008) examine the role of ASL proficiency in skilled and less skilled English readers and find that it is indeed a significant factor.

The role of cultural identity, prestige and social integration must also be taken into account as contributors to the motivation of L2 learners (see Chapters 8 and 12, this volume). The ability to use a language or to be perceived as a native speaker of a majority language is especially important for minority members of a heterogeneous society such as the United States (Valdés 2004, 2006). Education in the majority language, the sway of siblings and peers, media images that promote majority language and culture are all influences that contribute to L2 learning of the majority language by immigrant children (Montrul 2008).

Finally, robust quantity and quality of input is crucial to language development and maintenance (Piske and Young-Scholten 2009). It appears that even knowledge of vocabulary is dependent on quality of input, as Abrahamsson and Hyltenstam’s (2009) child learners reveal in their less than nativelike mastery of formulaic language (e.g. proverbs). This shortcoming could be attributed to their reduced exposure to traditional Swedish formulaic language, given their immigrant family home environment. Trofimovich and Baker (2006, 2007) demonstrate that learners require sufficient long-term experience with suprasegmentals (e.g. prosody and fluency factors) as well as segmentals (phonemes) for L2 phonology. They compare designated inexperienced and experienced adult (LoR three months vs. ten years) and child (LoR one year vs. eleven years) L2 learners; experienced learners outperform the inexperienced in both age groups, and the long-term child learners are often perceived as native. Summarizing, AoA is an important variable, but L1 influence, cognitive acuity, experience with the L2 and other external factors all have a role in L2 acquisition.

15.5 Conclusion

There is ample evidence that the human brain is experience expectant, biologically programmed to seek the necessary linguistic input (Bruer 1999) to learn a first language. Children learn language in a very systematic way cross-linguistically from birth to 4 years, with linguistic deficits if the trajectory is severely thwarted in some respect. The trajectory requires sufficient input received within an appropriate time frame. For subsequent languages, the human brain is experience dependent, biologically capable of learning
another language, but not necessarily destined to do so. The L2 will, like the L1, show concomitant deficits if sufficient input is not received within an appropriate time frame. Birth to 4 years is the very sensitive period for L1A or bilingual L1A; after 4 years L1A or additional language acquisition results in measurably deficient scrutinized proficiency (phonology, morphosyntax, lexicon or processing). Late childhood from 5 to 10 – during which time the brain continues to consolidate neural networks – is a period of offset in acquisition aptitude, resulting in deficits in L2 proficiency as perceived by native speakers. The decline in acquisition potential increases during the teen years and continues into adulthood as the brain’s ability to establish new neural networks diminishes. The general decline in language learning aptitude with increasing AoA is paralleled by a decline in implicit learning and inverse increase in explicit learning (M. Paradis 2009).

Deficits in endstate L2 include phonology, morphosyntax and processing differences from native monolingual performance. Pronunciation may deviate from the native profile in vowel space, consonant features and suprasegmentals. Morphosyntax is less vulnerable than phonology, but often reveals problems with features non-existent in the L1 and morphological performance errors. Comprehension and production in real-time processing also show deficits in slowed reaction time, lower accuracy and non-native processing strategies. Finally, as Abrahamsson and Hyltenstam emphasize, proficiency is not a monolithic and homogeneous ability comparable in all learners – individuals show different areas of expertise or deficit in L2 subdomains. So is there a sensitive period for L2A and what are its dimensions? The range of evidence presented in this chapter indicates that childhood is indeed a more sensitive period for acquiring a post-maternal language, but the period is not a critical one; it does not have a categorical terminus and its dimensions vary individually due to a number of additional external and internal factors.