# Supplementary Materials

Table S1: *Descriptive statistics for learners from 5 selected L1s and for all learners together (standard deviations in parentheses for all variables except Sex).*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Arabic (N=7510) | German (N=7245) | Serbian (N=2301) | Somali (N=411) | Turkish (N=2869) | Total (N=58299) |
| Speaking | 498.44 (33.03) | 549.48 (33.88) | 513.14 (30.39) | 481.18 (31.88) | 498.62 (39.53) | 517.56  (36.15) |
| Writing | 496.36 (41.07) | 556.88 (39.62) | 517.00 (37.91) | 482.35 (42.56) | 494.66 (47.05) | 520.86  (45.50) |
| Reading | 489.77 (24.78) | 561.67 (41.33) | 519.71 (32.28) | 487.36 (23.37) | 497.48 (30.51) | 520.77  (42.34) |
| Listening | 487.63 (25.91) | 545.29 (44.04) | 508.43 (32.21) | 484.22 (27.22) | 488.06 (29.59) | 510.62  (38.75) |
| Sex (Female) | 2860 (38.1%) | 5793 (80.0%) | 1469 (63.8%) | 82 (20.0%) | 1301 (45.3%) | 39561 (67.9%) |
| Age at arrival | 26.78 (5.95) | 25.57 (7.01) | 28.40 (6.73) | 26.32 (6.50) | 24.57 (5.07) | 27.13  (6.30) |
| Length of residence | 4.36  (4.09) | 1.69  (2.85) | 4.06  (3.05) | 5.59 (3.85) | 5.46  (5.51) | 3.90  (3.91) |
| Educational quality | -28.90 (21.55) | 21.97 (5.36) | 4.32  (6.50) | -68.44 (8.26) | -3.89 (23.30) | 0.53  (27.50) |
| Daily education | -0.02 (1.09) | -0.29 (1.07) | 0.12  (0.75) | -0.35 (1.00) | -0.17 (0.97) | 0.00  (1.00) |
| Lexical Distance | 1.00 | -1.88 | -0.03 | 1.00 | 1.00 | -0.02  (1.00) |
| Morphological Distance | 0.29 | -1.16 | 0.29 | -0.10 | 0.04 | -0.08  (0.82) |
| Phonological Distance | 1.15 | -1.48 | -0.60 | 1.15 | -1.13 | -0.02  (0.99) |

Table S2: *Parameter estimates for the speaking, writing, reading, and listening proficiency models (standard errors in parentheses), [standard deviations in brackets].*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Speaking | Writing | Reading | Listening |
| Intercept | 515.80\*\*\*  (1.82) | 511.80\*\*\*  (2.76) | 513.70\*\*\*  (2.70) | 513.80\*\*\*  (2.69) |
| *In model 1:* |  |  |  |  |
| Female | 6.48\*\*\*  (.30) | 7.92\*\*\*  (.39) | –.40  (.33) | –.40  (.33) |
| Age of arrival (AoA) | –1.09\*\*\*  (.04) | –.59\*\*\*  (.05) | –.51\*\*\*  (.05) | –.52\*\*\*  (.04) |
| (AoA)2 | –.01\*  (.00) | –.27\*\*\*  (.01) | –.05\*\*\*  (.01) | –.05\*\*\*  (.00) |
| (AoA)3 | .00  (.00) | .00  (.00) | .01\*\*  (.00) | .01\*\*  (.00) |
| Education | 2.76\*\*\*  (.15) | 5.23\*\*\*  (.19) | 5.76\*\*\*  (.17) | 5.80\*\*\*  (.17) |
| Gross enrolment | .17\*\*\*  (.02) | –.18\*\*\*  (.02) | .06\*\*  (.02) | .07\*\*\*  (.02) |
| Female x Gross enrolment | –.06\*\*\*  (.01) | .02  (.01) | –.04\*\*\*  (.01) | –-.04\*\*\*  (.01) |
| Education x Gross enrolment | .02\*\*\*  (.00) | .01  (.01) | .07\*\*\*  (.01) | .07\*\*\*  (.01) |
|  | | | | |
| *In model 2:* |  |  |  |  |
| Length of residence  (LoR) | .59\*\*\*  (.09) | –1.33\*\*\*  (.12) | .29\*\*\*  (.08) | –.10  (.06) |
| (LoR)2 | –.00  (.00) | .05\*\*\*  (.01) | .02\*\*\*  (.00) | .01\*\*\*  (.00) |
| AoA x LoR | –.08\*\*\*  (.01) | –.04\*\*\*  (.01) | –.04\*\*\*  (.00) | –.04\*\*\*  (.01) |
| *In model 3:* |  |  |  |  |
| Lexical distance (LEX) | –7.19\*\*\*  (1.46) | –10.88\*\*\*  (2.04) | –10.25\*\*\*  (2.24) | –10.34\*\*\*  (2.24) |
| LEX2 | –.79  (1.20) | –2.12  (1.68) | 1.63  (1.83) | 1.68  (1.52) |
| Morphological distance (MOR) | –6.28\*\*\*  (1.54) | –4.44\*  (2.16) | –3.35  (2.30) | –3.39  (2.30) |
| MOR2 | 1.14\*\*\*  (.32) | 1.11\*  (.45) | .84  (.48) | .87  (.48) |
| Phonological distance (PHON) | –2.41\*  (1.06) | –2.64  (1.47) | –2.90  (1.63) | –2.89  (1.64) |
| PHON2 | 1.62  (1.02) | 4.47\*\*  (1.44) | 1.68  (1.52) | 1.66  (1.52) |
| *In model 5:* |  |  |  |  |
| LEX x AoA | –.04  (.05) | –.14\*  (.06) | –.02  (.05) | .01  (.05) |
| LEX2 x AoA | .11\*\*\*  (.03) | .06  (.04) | .11\*\*  (.03) | .10\*\*  (.03) |
| MOR x AoA | –.06  (.05) | –.09  (.07) | –.20\*\*\*  (.06) | –.21\*\*\*  (.06) |
| MOR2 x AoA | .04\*\*  (.01) | .05\*\*  (.02) | .04\*\*  (.01) | .05\*\*  (.01) |
| PHON x AoA | –.09\*\*  (.03) | –.03  (.04) | –.03  (.03) | –.04  (.03) |
| PHON2 x AoA | .15\*\*\*  (.04) | .12\*\*  (.05) | .11\*\*  (.04) | .12\*\*  (.04) |
| *Variance components* |  |  |  |  |
| Residual | 874  [29.57] | 1,429  [37.80] | 1,050  [32.35] | 1,016  [31.87] |
| Variance L1 | 20.88  [4.57] | 39.27  [6.27] | 56.98  [7.55] | 36.17  [6.01] |
| Variance L2 | 16.62  [4.08] | 39.71  [6.30] | 32.64  [5.71] | 24.62  [4.96] |
| Variance L1 x L2 | 6.45  [2.54] | 22.04  [4.69] | 18.50  [4.30] | 10.03  [3.17] |
| LoR (Random slope on L1L2) | .50  [.71] | 1.01  [1.01] | .28  [.41] | .24  [.49] |
| Variance Country | 65.79  [8.11] | 248.73  [15.77] | 155.22  [12.46] | 44.28  [9.69] |
| REML (*df* = 31) | 539,371 | 567,069 | 549,742 | 547,710 |

\*: *p* < .05; \*\*: *p* < .01; \*\*\*: *p* < .001

Table S3: *Model comparison for the speaking (S), writing (W), reading (R), and listening (L) models.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Model | *df* | *AIC* | *BIC* | *deviance* | *–ΔChi2* | *Δdf* |
| S0 | 6 | 543157 | 543211 | 543145 |  |  |
| S1 | 14 | 541069 | 541195 | 541041 | 2103 | 8 |
| S2 | 17 | 540189 | 540341 | 540155 | 886 | 3 |
| S3 | 23 | 540133 | 540338 | 540087 | 69 | 6 |
| S4 | 29 | 539736 | 539995 | 539678 | 409 | 6 |
| S5 | 31 | 539333 | 539610 | 539271 | 407 | 2 |
| W0 | 6 | 569488 | 569542 | 569476 |  |  |
| W1 | 14 | 569277 | 569358 | 569259 | 217 | 8 |
| W2 | 17 | 567822 | 567973 | 567788 | 1471 | 3 |
| W3 | 23 | 567778 | 567984 | 567732 | 55 | 6 |
| W4 | 29 | 567527 | 567786 | 567469 | 264 | 6 |
| W5 | 31 | 567044 | 567321 | 566982 | 486 | 2 |
| R0 | 6 | 551922 | 551976 | 551910 |  |  |
| R1 | 14 | 550145 | 550270 | 550117 | 1793 | 8 |
| R2 | 17 | 550038 | 550190 | 550004 | 112 | 3 |
| R3 | 23 | 550000 | 550206 | 549954 | 50 | 6 |
| R4 | 29 | 549777 | 550036 | 549719 | 235 | 6 |
| R5 | 31 | 549713 | 499990 | 549651 | 68 | 2 |
| L0 | 6 | 549900 | 549954 | 549888 |  |  |
| L1 | 14 | 548729 | 548854 | 548701 | 1187 | 8 |
| L2 | 17 | 548209 | 548361 | 548175 | 526 | 3 |
| L3 | 23 | 548171 | 548377 | 548125 | 50 | 6 |
| L4 | 29 | 547773 | 548032 | 547715 | 410 | 6 |
| L5 | 31 | 547676 | 547953 | 547614 | 101 | 2 |

*Note. All model comparisons in the table are significant at the p < .0001 level.*

Table S4: *Marginal and Conditional R2 for the speaking, writing, reading, and listening models.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Speaking  Marginal *R2*  (Conditional *R2*) | Writing  Marginal *R2*  (Conditional *R2*) | Reading  Marginal *R2*  (Conditional *R2*) | Listening  Marginal *R2*  (Conditional *R2*) |
| 0 | .00 (.24) | .00 (.22) | .00 (.29) | .00 (.21) |
| 1 | .04 (.24) | .00 (.23) | .03 (.29) | .04 (.20) |
| 2 | .07 (.25) | .03 (.25) | .03 (.29) | .06 (.22) |
| 3 | .24 (.32) | .12 (.27) | .19 (.35) | .23 (.31) |
| 4 | .24 (.32) | .12 (.27) | .20 (.35) | .23 (.31) |
| 5 | .23 (.32) | .11 (.29) | .19 (.35) | .23 (.31) |

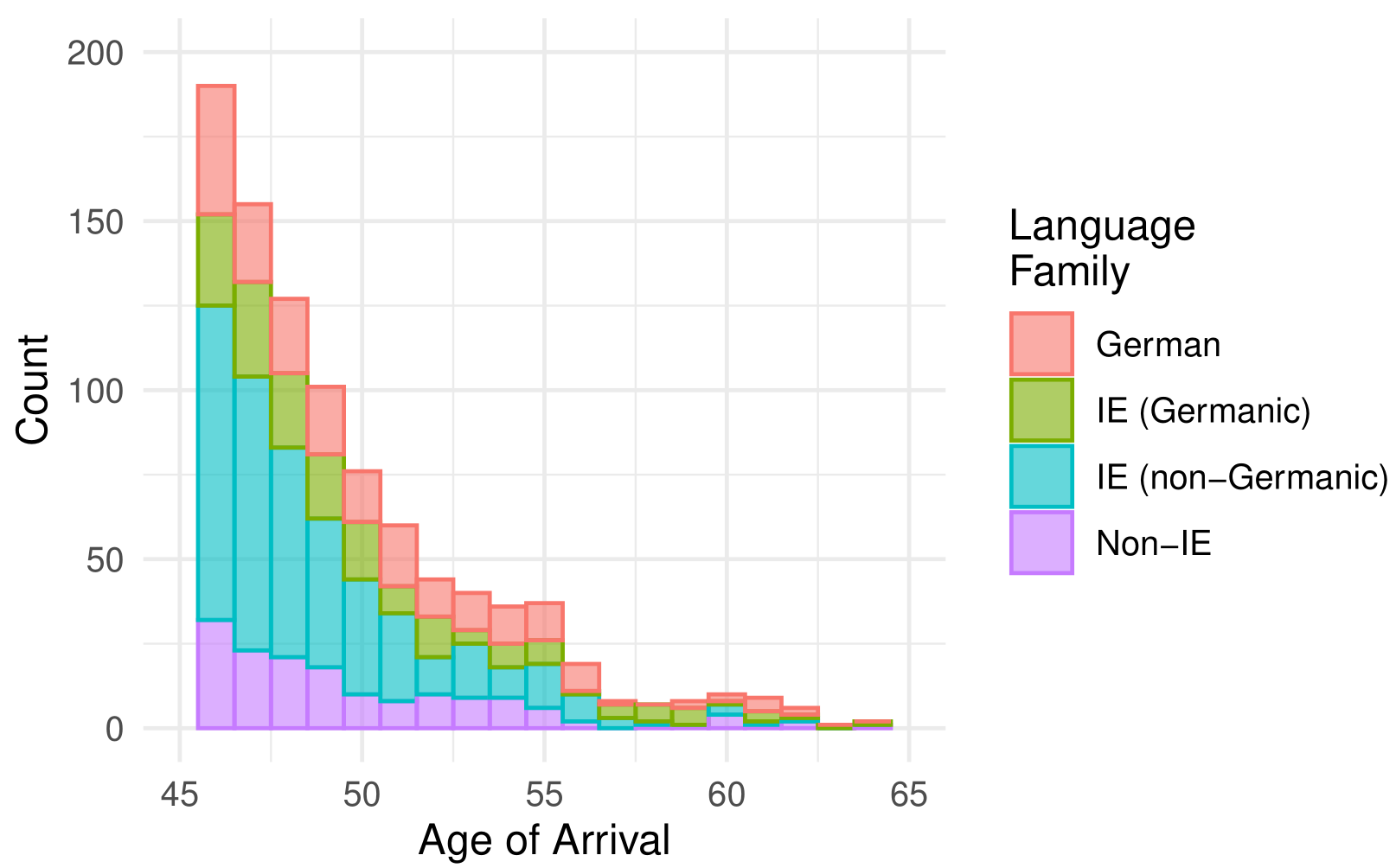


Figure S1. *Age of arrival distribution for learners by their language background; IE = Indo-European. The figure shows only learners older than 45 to focus on the ages where fewer scores are available (only a small percentage of all learners).*

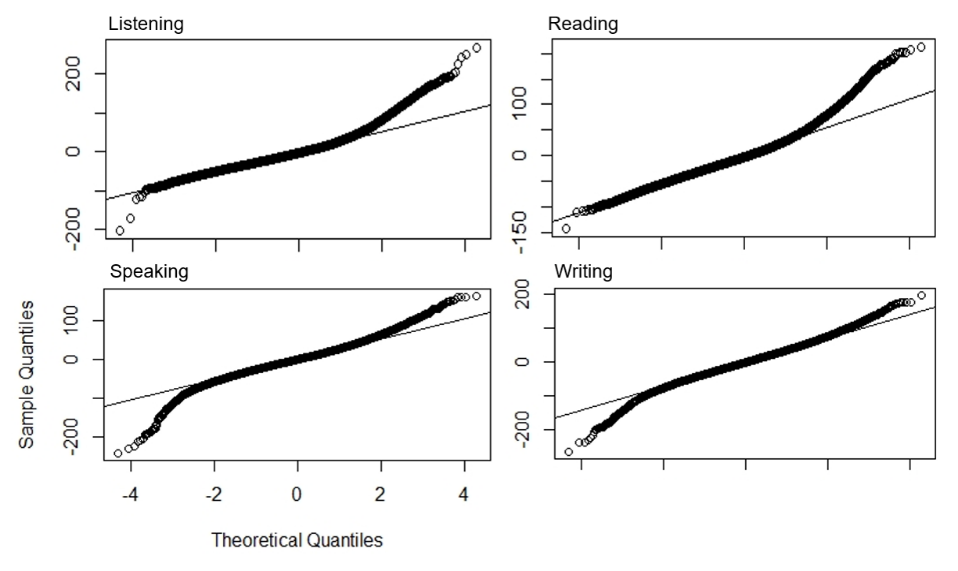
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Figure S2: *Q-Q plots of residual scores for the speaking, writing, listening and reading models 5.*