



Figure A1 Vowels /i/ and /u/ compared in Polish, Russian and Ukrainian.



Figure A2 Potential effect of the time spent in the United States. “Old” immigrants (over 1 year of stay in the United States) compared to “new” immigrants (stay in the United States ≥ 1 year).

Table A1 Statistical analysis summary. p-values in the comparisons of high vowels between the languages and the complete outputs from our linear mixed-effects models.

Table A1.1 Tongue root frontness

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| xTR |  /ɨ/ | /u/ | /i/ | Data restricted to individual Vowels /ɨ, u, i/. Response variable xTR (tongue root frontness), fixed effects Language and Place, random factor Speaker. |
| Rus | Pol | Rus | Pol | Rus | Pol |
| Pol | p=0.254 |   | p=0.573 |   | p=0.72 |   |
| Ukr | **p=0.045** | p=0.428 | **p=0.038** | p=0.158 | p=0.424 | p=0.683 |
| PlaceLabial | **p=0.006** | **p <0.001** | p=0.781 |

|  |
| --- |
| Fronting for Tongue Root (xTR) for vowel /i/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Polish/coronal | -2.4104 | 0.3741 | -6.443 | **<0.001** |
| Language (Polish vs. Russian) | -0.1805 | 0.5021 | -0.359 | 0.72 |
| Language (Polish vs. Ukrainian) | 0.2067 | 0.505 | 0.409 | 0.683 |
| Place (labial vs. coronal) | 0.0299 | 0.1071 | 0.279 | 0.781 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Russian/coronal | -2.5909 | 0.3432 | -7.549 | **<0.001** |
| Language (Russian vs. Ukrainian) | 0.3872 | 0.4827 | 0.802 | 0.424 |
| Language (Russian vs. Polish) | 0.1205 | 0.5021 | 0.359 | 0.72 |
| Place (labial vs. coronal) | 0.0299 | 0.1071 | 0.279 | 0.781 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.9771 | 0.9885 |  |
| Residual |  | 0.3257 | 0.5707 |  |

|  |
| --- |
| Fronting for Tongue Root (xTR) for vowel /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Polish/coronal | -2.913 | 0.3242 | -8.984 | **<0.001** |
| Language (Polish vs. Russian) | -0.4962 | 0.4322 | -1.148 | 0.254 |
| Language (Polish vs. Ukrainian) | 0.3462 | 0.4355 | 0.795 | 0.428 |
| Place (labial vs. coronal) | -0.2989 | 0.1055 | -2.833 | **0.006** |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Russian/coronal | -3.4092 | 0.2952 | -11.549 | **<0.00**1 |
| Language (Russian vs. Ukrainian) | 0.8424 | 0.4144 | 2.033 | **0.045** |
| Language (Russian vs. Polish) | 0.4962 | 0.4322 | 1.148 | 0.254 |
| Place (labial vs. coronal) | -0.2989 | 0.1055 | -2.833 | **0.006** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.7036 | 0.8388 |  |
| Residual |  | 0.3159 | 0.5621 |  |

|  |
| --- |
| Fronting for Tongue Root (xTR) for vowel /u/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Polish/coronal | -3.9458 | 0.3314 | -11.906 | **<0.00**1 |
| Language (Polish vs. Russian) | -0.2463 | 0.4359 | -0.565 | 0.573 |
| Language (Polish vs. Ukrainian) | 0.6265 | 0.4407 | 1.421 | 0.158 |
| Place (labial vs. coronal) | -0.6929 | 0.1294 | -5.356 | **<0.00**1 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Russian/coronal | -4.1922 | 0.2973 | -14.101 | **<0.001** |
| Language (Russian vs. Ukrainian) | 0.8728 | 0.4159 | 2.099 | **0.038** |
| Language (Russian vs. Polish) | 0.2463 | 0.4359 | 0.565 | 0.573 |
| Place (labial vs. coronal) | -0.6929 | 0.1294 | -5.256 | **<0.001** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.6743 | 0.8211 |  |
| Residual |  | 0.4752 | 0.6893 |  |

Table A1.2 Tongue root height

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| yTR | / ɨ/ | /u/ | /i/ | Data restricted to individual Vowels /ɨ, u, i/. Response variable: yTR, fixed effects Language and Place, random factor Speaker. |
| Rus | Pol | Rus | Pol | Rus | Pol |
| Pol | **p=0.045** |   | p=0.107 |   | p=0.27 |   |
| Ukr | p=0.450 | p=0.199 | p=0.78 | p=0.182 | p=0.532 | p=0.615 |
| PlaceLabial | p=0.460 | **p<0.001** | p=0.215 |

|  |
| --- |
| Raising for Tongue Root (yTR) for vowel /i/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Polish/coronal | -1.3266 | 0.388 | -3.419 | **0.001** |
| Language (Polish vs. Russian) | 0.5703 | 0.5148 | 1.108 | 0.27 |
| Language (Polish vs. Ukrainian) | 0.2616 | 0.5193 | 0.504 | 0.615 |
| Place (labial vs. coronal) | -0.1693 | 0.1357 | -1.248 | 0.215 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Russian/coronal | -0.7564 | 0.3514 | -2.152 | **0.034** |
| Language (Russian vs. Ukrainian) | -0.3087 | 0.4927 | -0.627 | 0.532 |
| Language (Russian vs. Polish) | -0.5703 | 0.5148 | -1.108 | 0.27 |
| Place (labial vs. coronal) | -0.1693 | 0.1357 | -1.248 | 0.215 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.9779 | 0.9889 |  |
| Residual |  | 0.5228 | 0.723 |  |

|  |
| --- |
| Raising for Tongue Root (yTR) for vowel /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Polish/coronal | -1.2484 | 0.3522 | -3.545 | **0.001** |
| Language (Polish vs. Russian) | 0.9238 | 0.455 | 2.031 | **0.045** |
| Language (Polish vs. Ukrainian) | 0.5972 | 0.4623 | 1.292 | 0.199 |
| Place (labial vs. coronal) | -0.1213 | 0.1636 | -0.742 | 0.46 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Russian/coronal | -0.3246 | 0.3099 | -1.047 | 0.297 |
| Language (Russian vs. Ukrainian) | -0.3267 | 0.4313 | -0.757 | 0.45 |
| Language (Russian vs. Polish) | -0.9238 | 0.455 | -2.031 | **0.045** |
| Place (labial vs. coronal) | -0.1213 | 0.1613 | -0.742 | 0.46 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.6706 | 0.8189 |  |
| Residual |  | 0.7602 | 0.8719 |  |

|  |
| --- |
| Raising for Tongue Root (yTR) for vowel /u/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Polish/coronal | -0.537 | 0.426 | -1.262 | 0.21 |
| Language (Polish vs. Russian) | 0.9079 | 0.5582 | 1.627 | 0.107 |
| Language (Polish vs. Ukrainian) | 0.7592 | 0.5649 | 1.344 | 0.182 |
| Place (labial vs. coronal) | -0.7286 | 0.1733 | -4.204 | **<0.00**1 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Russian/coronal | 0.3708 | 0.3805 | 0.975 | 0.332 |
| Language (Russian vs. Ukrainian) | -0.1487 | 0.5318 | -0.28 | 0.78 |
| Language (Russian vs. Polish) | -0.9079 | 0.5582 | -1.627 | 0.107 |
| Place (labial vs. coronal) | -0.7286 | 0.1733 | -4.204 | **<0.001** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 1.0859 | 1.042 |  |
| Residual |  | 0.8527 | 0.9234 |  |

Table A1.3 Tongue dorsum frontness

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| xTB | / ɨ/ | /u/ | /i/ | Data restricted to individual Vowels / ɨ, u, i/. Response variable xTB, fixed effects Language and Place, random factor Speaker |
| Rus | Pol | Rus | Pol | Rus | Pol |
| Pol | **p=0.007** |   | p=0.183 |   | p=0.749 |   |
| Ukr | p=0.693 | **p=0.019** | p=0.328 | p=0.692 | p=0.185 | p=0.118 |
| Place | p=0.127 | **p<0.001** | p=0.788 |

|  |
| --- |
| Fronting for Tongue Dorsum (xTB) for vowel /i/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Polish/coronal | 2.7975 | 0.3486 | 8.024 | **<0.001** |
| Language (Polish vs. Russian) | -0.1474 | 0.4596 | -0.321 | 0.749 |
| Language (Polish vs. Ukrainian) | -0.7326 | 0.4643 | -1.578 | 0.118 |
| Place (labial vs. coronal) | 0.0357 | 0.1325 | 0.27 | 0.788 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Russian/coronal | 2.6501 | 0.3135 | 8.453 | **<0.001** |
| Language (Russian vs. Ukrainian) | -0.5852 | 0.4389 | -1.334 | 0.185 |
| Language (Russian vs. Polish) | 0.1474 | 0.4596 | 0.321 | 0.749 |
| Place (labial vs. coronal) | 0.0357 | 0.1325 | 0.27 | 0.788 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.7575 | 0.8703 |  |
| Residual |  | 0.4984 | 0.706 |  |

|  |
| --- |
| Fronting for Tongue Dorsum (xTB) for vowel /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Polish/coronal | 2.1303 | 0.3535 | 6.025 | **<0.001** |
| Language (Polish vs. Russian) | -1.3025 | 0.4696 | -2.774 | **0.007** |
| Language (Polish vs. Ukrainian) | -1.1243 | 0.4736 | -2.374 | **0.019** |
| Place (labial vs. coronal) | -0.187 | 0.1216 | -1.538 | 0.127 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Russian/coronal | 0.8278 | 0.3206 | 2.582 | **0.011** |
| Language (Russian vs. Ukrainian) | 0.1782 | 0.4497 | 0.396 | 0.693 |
| Language (Russian vs. Polish) | 1.3025 | 0.4696 | 2.774 | **0.007** |
| Place (labial vs. coronal) | -0.187 | 0.1216 | -1.538 | 0.127 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.818 | 0.9044 |  |
| Residual |  | 0.4195 | 0.6477 |  |

|  |
| --- |
| Fronting for Tongue Dorsum (xTB) for vowel /u/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Polish/coronal | -0.0238 | 0.3625 | -0.066 | 0.948 |
| Language (Polish vs. Russian) | -0.6451 | 0.4812 | -1.341 | 0.183 |
| Language (Polish vs. Ukrainian) | -0.1926 | 0.4854 | -0.397 | 0.692 |
| Place (labial vs. coronal) | -0.5491 | 0.1259 | -4.363 | **<0.001** |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Russian/coronal | -0.669 | 0.3285 | -2.037 | **0.044** |
| Language (Russian vs. Ukrainian) | 0.4525 | 0.4607 | 0.982 | 0.328 |
| Language (Russian vs. Polish) | 0.6451 | 0.4812 | 1.341 | 0.183 |
| Place (labial vs. coronal) | -0.549 | 0.1259 | -4.363 | **<0.001** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.8564 | 0.9254 |  |
| Residual |  | 0.4495 | 0.6705 |  |

Table A1.4 Tongue dorsum height

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| yTB | / ɨ/ | /u/ | /i/ | Data restricted to individual Vowels / ɨ, u, i/. Response variable yTB, fixed effects Language and Place, random factor Speaker. |
| Rus | Pol | Rus | Pol | Rus | Pol |
| Pol | p=0.528 |   | p=0.450 |   | p=0.291 |   |
| Ukr | p=0.179 | p=0.502 | p=0.227 | p=0.68 | p=0.485 | p=0.086 |
| Place | p=0.183 | **p<0.001** | **p=0.014** |

|  |
| --- |
| Raising for Tongue Dorsum (yTB) for vowel /i/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Polish/coronal | 3.541 | 0.3115 | 11.37 | **<0.001** |
| Language (Polish vs. Russian) | -0.451 | 0.4252 | -1.061 | 0.291 |
| Language (Polish vs. Ukrainian) | -0.739 | 0.4258 | -1.735 | 0.086 |
| Place (labial vs. coronal) | -0.1202 | 0.0481 | -2.498 | **0.014** |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Russian/coronal | 3.0904 | 0.2913 | 10.608 | **<0.001** |
| Language (Russian vs. Ukrainian) | -0.288 | 0.4116 | -0.7 | 0.485 |
| Language (Russian vs. Polish) | 0.451 | 0.4252 | 1.061 | 0.291 |
| Place (labial vs. coronal) | -0.1202 | 0.0481 | -2.498 | **0.014** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.747 | 0.8643 |  |
| Residual |  | 0.0657 | 0.2563 |  |

|  |
| --- |
| Raising for Tongue Dorsum (yTB) for vowel /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Polish/coronal | 2.739 | 0.3447 | 7.946 | **<0.001** |
| Language (Polish vs. Russian) | 0.2977 | 0.4699 | 0.633 | 0.528 |
| Language (Polish vs. Ukrainian) | -0.3168 | 0.4709 | -0.673 | 0.502 |
| Place (labial vs. coronal) | 0.0771 | 0.0576 | 1.341 | 0.183 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Russian/coronal | 3.0367 | 0.322 | 9.432 | **<0.001** |
| Language (Russian vs. Ukrainian) | -0.6145 | 0.4545 | -1.352 | 0.179 |
| Language (Russian vs. Polish) | -0.2977 | 0.4699 | -0.633 | 0.528 |
| Place (labial vs. coronal) | 0.07711 | 0.576 | 1.341 | 0.183 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.909 | 0.9534 |  |
| Residual |  | 0.0938 | 0.3062 |  |

|  |
| --- |
| Raising for Tongue Dorsum (yTB) for vowel /u/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Polish/coronal | 2.89 | 0.2923 | 9.888 | **<0.001** |
| Language (Polish vs. Russian) | 0.301 | 0.397 | 0.758 | 0.45 |
| Language (Polish vs. Ukrainian) | -0.1648 | 0.3981 | -0.414 | 0.68 |
| Place (labial vs. coronal) | 0.2176 | 0.0592 | 3.674 | **<0.001** |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Russian/coronal | 3.191 | 0.2718 | 11.74 | **<0.001** |
| Language (Russian vs. Ukrainian) | -0.4657 | 0.3833 | -1.215 | 0.227 |
| Language (Russian vs. Polish) | -0.301 | 0.397 | -0.758 | 0.45 |
| Place (labial vs. coronal) | 0.2176 | 0.0592 | 3.674 | **<0.001** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.6395 | 0.7997 |  |
| Residual |  | 0.0995 | 0.3155 |  |

Table A2 Mean values

Table A2.1 Mean values in *cm* (non-normalized)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Polish | Ukrainian | Russian |
|  | i | ɨ | u | i | ɨ | u | i | ɨ | u |
| xTR | 3.777 | 3.144 | 2.495 | 4.062 | 3.854 | 3.214 | 3.148 | 2.588 | 2.066 |
| yTR | 4.186 | 4.220 | 4.699 | 4.876 | 5.003 | 5.113 | 4.146 | 4.307 | 4.571 |
| xTB | 6.838 | 6.004 | 4.859 | 6.482 | 5.860 | 4.944 | 6.318 | 5.149 | 4.127 |
| yTB | 6.697 | 6.263 | 6.712 | 6.892 | 6.846 | 7.061 | 6.432 | 6.488 | 6.529 |

Table A2.2 Mean and median (normalized)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Polish | Ukrainian | Russian |
|  | i | ɨ | u | i | ɨ | u | i | ɨ | u |
| xTR meanmedian | -1.997-2.152 | -2.803-2.947 | -4.389-4.199 | -2.083-2.133 | -2.682-2.718 | -3.750-3.750 | -2.352-2.608 | -3.536-3.606 | -4.361-4.560 |
| yTR meanmedian | -1,369-1.622 | -1.591-1.431 | -1.056-1.026 | -0.888-1.129 | -0.618-0.689 | -0.105-0.100 | -0.760-0.845 | -0.129-0.370 | -0.017-0.015 |
| xTB meanmedian | 2.6972.901 | 2.5682.603 | -0.512-0.354 | 1.9812.092 | 1.0230.895 | -0.615-0.519 | 2.8682.689 | 0.6600.756 | -0.911-0.925 |
| yTB meanmedian | 3.3233.460 | 2.8602.961 | 3.0462.931 | 2.8532.738 | 2.2132.415 | 2.8672.807 | 3.1763.045 | 2.9523.089 | 3.1753.322 |

Table A3 The differences between the high vowels within individual languages shown by the complete linear-mixed effects model outputs

|  |  |  |  |
| --- | --- | --- | --- |
|   | Polish | Russian | Ukrainian |
|   |  /ɨ/ | /u/ |  /ɨ/ | /u/ |  /ɨ/ | /u/ |
| tongue root fronting (xTR) |
| /u/ | **<0.001** |   | **<0.001** |   | **<0.001** |   |
| /i/ | **<0.001** | **<0.001** | **<0.001** | **<0.001** | **0.006** | **<0.001** |
| tongue root raising (yTR) |
| /u/ | 0.056 |   | **0.027** |   | **0.014** |   |
| /i/ | 0.362 | **0.005** | **0.007** | **<0.001** | 0.066 | **<0.001** |
| dorsum fronting (xTB) |
| /u/ | **<0.001** |  | **<0.001** |  | **<0.001** |  |
| /i/ | **<0.001** | **<0.001** | **<0.001** | **<0.001** | **<0.001** | **<0.001** |
| dorsum raising (yTB) |
| /u/ | **<0.001** |  | **0.002** |  | **<0.001** |   |
| /i/ | **<0.001** | **<0.001** | 0.542 | **<0.001** | **0.002** | 0.503 |

Table A3.1 The differences between the high vowels in Polish

|  |
| --- |
| Fronting for Tongue Root (xTR) for Polish |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel i /coronal | -2.1832 | 0.2613 | -8.355 | **<0.001** |
| Vowel (i vs. ɨ) | -0.7949 | 0.1435 | -5.537 | **<0.001** |
| Vowel (i vs. u) | -2.0475 | 0.1435 | -14.263 | **<0.001** |
| Place (labial vs. coronal) | -0.2566 | 0.1172 | -2.189 | **0.032** |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel u /coronal | -4.2307 | 0.2613 | -16.19 | **<0.001** |
| Vowel (i vs. u) | 2.0475 | 0.1435 | 14.263 | **<0.001** |
| Vowel (ɨ vs. u) | 1.2526 | 0.1435 | 8.726 | **<0.001** |
| Place (labial vs. coronal) | -0.2566 | 0.1172 | -2.189 | **0.032** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.4283 | 0.6545 |  |
| Residual |  | 0.2885 | 0.5371 |  |

|  |
| --- |
| Raising for Tongue Root (yTR) for Polish |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel i /coronal | -1.2592 | 0.2697 | -4.668 | **<0.001** |
| Vowel (i vs. ɨ) | 0.191 | 0.2084 | 0.917 | 0.362 |
| Vowel (i vs. u) | 0.5961 | 0.2084 | 2.86 | **0.005** |
| Place (labial vs. coronal) | -0.409 | 0.1702 | -2.403 | **0.019** |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel u /coronal | -0.6631 | 0.2697 | -2.458 | **0.016** |
| Vowel (i vs. u) | -0.5961 | 0.2084 | -2.86 | **0.005** |
| Vowel (ɨ vs. u) | -0.4051 | 0.2084 | -1.944 | 0.056 |
| Place (labial vs. coronal) | -0.409 | 0.1702 | -2.403 | **0.019** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.335 | 0.5788 |  |
| Residual |  | 0.6082 | 0.7798 |  |

|  |
| --- |
| Fronting for Tongue Dorsum (xTB) for Polish |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel i /coronal | 3.0191 | 0.231 | 13.069 | **<0.001** |
| Vowel (i vs. ɨ) | -0.7953 | 0.1807 | -4.402 | **<0.001** |
| Vowel (i vs. u) | -3.2545 | 0.1807 | -18.013 | **<0.001** |
| Place (labial vs. coronal) | -0.3025 | 0.1475 | -2.051 | **0.044** |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel u /coronal | -0.2354 | 0.231 | -1.019 | 0.311 |
| Vowel (i vs. u) | 3.2545 | 0.1807 | 18.013 | **<0.001** |
| Vowel (ɨ vs. u) | 2.4592 | 0.1807 | 13.611 | **<0.001** |
| Place (labial vs. coronal) | -0.3025 | 0.1475 | -2.051 | **0.044** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.2414 | 0.4913 |  |
| Residual |  | 0.457 | 0.676 |  |

|  |
| --- |
| Raising for Tongue Dorsum (yTB) for Polish |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel i /coronal | 3.56175 | 0.2065 | 17.248 | **<0.001** |
| Vowel (i vs. ɨ) | -0.85728 | 0.0897 | -9.558 | **<0.001** |
| Vowel (i vs. u) | -0.52889 | 0.0897 | -5.896 | **<0.001** |
| Place (labial vs. coronal) | -0.02822 | 0.07324 | -0.385 | 0.701 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel u /coronal | 3.03286 | 0.2065 | 14.687 | **<0.001** |
| Vowel (i vs. u) | 0.52889 | 0.0897 | 5.896 | **<0.001** |
| Vowel (ɨ vs. u) | -0.32839 | 0.0897 | -3.661 | **<0.001** |
| Place (labial vs. coronal) | -0.02822 | 0.07324 | -0.385 | 0.701 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.295 | 0.5431 |  |
| Residual |  | 0.1126 | 0.3356 |  |

Table A3.2 The differences between the high vowels in Ukrainian

|  |
| --- |
| Fronting for Tongue Root (xTR) for Ukrainian |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel i /coronal | -1.9848 | 0.2682 | -7.4 | **<0.001** |
| Vowel (i vs. ɨ) | -0.5852 | 0.2077 | -2.817 | **0.006** |
| Vowel (i vs. u) | -1.5263 | 0.2077 | -7.347 | **<0.001** |
| Place (labial vs. coronal) | -0.3342 | 0.1703 | -1.962 | 0.053 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel u /coronal | -3.5111 | 0.2682 | -13.091 | **<0.001** |
| Vowel (i vs. u) | 1.5263 | 0.2077 | 7.347 | **<0.001** |
| Vowel (ɨ vs. u) | 0.9411 | 0.2077 | 4.53 | **<0.001** |
| Place (labial vs. coronal) | -0.3342 | 0.1703 | -1.962 | 0.053 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.3921 | 0.6261 |  |
| Residual |  | 0.7553 | 0.7553 |  |

|  |
| --- |
| Fronting for Tongue Root (xTR) for Ukrainian |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel i /coronal | -1.9848 | 0.2682 | -7.4 | **<0.001** |
| Vowel (i vs. ɨ) | -0.5852 | 0.2077 | -2.817 | **0.006** |
| Vowel (i vs. u) | -1.5263 | 0.2077 | -7.347 | **<0.001** |
| Place (labial vs. coronal) | -0.3342 | 0.1703 | -1.962 | 0.053 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel u /coronal | -3.5111 | 0.2682 | -13.091 | **<0.001** |
| Vowel (i vs. u) | 1.5263 | 0.2077 | 7.347 | **<0.001** |
| Vowel (ɨ vs. u) | 0.9411 | 0.2077 | 4.53 | **<0.001** |
| Place (labial vs. coronal) | -0.3342 | 0.1703 | -1.962 | 0.053 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.3921 | 0.6261 |  |
| Residual |  | 0.7553 | 0.7553 |  |

|  |
| --- |
| Fronting for Tongue Dorsum (xTB) for Ukrainian |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel i /coronal | 2.2052 | 0.4547 | 4.85 | **<0.001** |
| Vowel (i vs. ɨ) | -1.197 | 0.2255 | -5.309 | **<0.001** |
| Vowel (i vs. u) | -2.6113 | 0.2255 | -11.581 | **<0.001** |
| Place (labial vs. coronal) | -0.1979 | 0.1849 | -1.07 | 0.287 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel u /coronal | -0.4061 | 0.4547 | -0.893 | 0.374 |
| Vowel (i vs. u) | 2.6113 | 0.2255 | 11.581 | **<0.001** |
| Vowel (ɨ vs. u) | 1.4143 | 0.2255 | 6.272 | **<0.001** |
| Place (labial vs. coronal) | -0.1979 | 0.1849 | -1.07 | 0.287 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 1.5598 | 1.2489 |  |

|  |
| --- |
| Raising for Tongue Dorsum (yTB) for vowel Ukrainian |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel i /coronal | 2.72762 | 0.35236 | 7.741 | **<0.001** |
| Vowel (i vs. ɨ) | -0.32259 | 0.10337 | -3.121 | **0.002** |
| Vowel (i vs. u) | 0.06941 | 0.10337 | 0.672 | 0.503 |
| Place (labial vs. coronal) | 0.07312 | 0.08479 | 0.862 | 0.391 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel u /coronal | 2.79703 | 0.35236 | 7.938 | **<0.001** |
| Vowel (i vs. u) | -0.06941 | 0.10337 | -0.672 | 0.503 |
| Vowel (ɨ vs. u) | -0.392 | 0.10337 | -3.792 | **<0.001** |
| Place (labial vs. coronal) | 0.07312 | 0.08479 | 0.862 | 0.391 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 1.054 | 1.0267 |  |
| Residual |  | 0.187 | 0.4324 |  |

Table A3.3 The differences between the high vowels in Russian

|  |
| --- |
| Fronting for Tongue Root (xTR) for Russian |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel i /coronal | -2.3998 | 0.3624 | -6.622 | **<0.001** |
| Vowel (i vs. ɨ) | -0.9966 | 0.135 | -7.381 | **<0.001** |
| Vowel (i vs. u) | -1.9515 | 0.135 | -14.453 | **<0.001** |
| Place (labial vs. coronal) | -0.3454 | 0.1105 | -3.127 | **0.002** |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel u /coronal | -4.3513 | 0.3624 | -12.007 | **<0.001** |
| Vowel (i vs. u) | 1.9515 | 0.135 | 14.453 | **<0.001** |
| Vowel (ɨ vs. u) | 0.9549 | 0.135 | 7.072 | **<0.001** |
| Place (labial vs. coronal) | -0.3454 | 0.1105 | -3.127 | **0.002** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 1.0732 | 1.0359 |  |
| Residual |  | 0.4649 | 0.6818 |  |

|  |
| --- |
| Raising for Tongue Root (yTR) for Russian |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel i /coronal | -0.7205 | 0.1915 | -3.763 | **<0.001** |
| Vowel (i vs. ɨ) | 0.4747 | 0.1732 | 2.741 | **0.007** |
| Vowel (i vs. u) | 0.8604 | 0.1732 | 4.969 | **<0.001** |
| Place (labial vs. coronal) | -0.2601 | 0.1416 | -1.837 | 0.068 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel u /coronal | 0.1399 | 0.1915 | 0.73 | 0.466 |
| Vowel (i vs. u) | -0.8604 | 0.1732 | -4.969 | **<0.001** |
| Vowel (ɨ vs. u) | -0.3857 | 0.1732 | -2.227 | **0.027** |
| Place (labial vs. coronal) | -0.2601 | 0.1416 | -1.837 | 0.068 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.1512 | 0.3889 |  |
| Residual |  | 0.7646 | 0.8744 |  |

|  |
| --- |
| Fronting for Tongue Dorsum (xTB) for Russian |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel i /coronal | 2.7797 | 0.1544 | 18.007 | **<0.001** |
| Vowel (i vs. ɨ) | -1.9311 | 0.1404 | -13.757 | **<0.001** |
| Vowel (i vs. u) | -3.6117 | 0.1404 | -25.73 | **<0.001** |
| Place (labial vs. coronal) | -0.2179 | 0.1148 | -1.898 | 0.06 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel u /coronal | -0.832 | 0.1544 | -5.39 | **<0.001** |
| Vowel (i vs. u) | 3.6117 | 0.1404 | 25.73 | **<0.001** |
| Vowel (ɨ vs. u) | 1.6807 | 0.1404 | 11.973 | **<0.001** |
| Place (labial vs. coronal) | -0.2179 | 0.1148 | -1.898 | 0.06 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.09704 | 0.3115 |  |
| Residual |  | 0.50245 | 0.7088 |  |

|  |
| --- |
| Raising for Tongue Dorsum (yTB) for vowel Russian |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel i /coronal | 2.98 | 0.28598 | 10.42 | **<0.001** |
| Vowel (i vs. ɨ) | 0.04426 | 0.07238 | 0.611 | 0.542 |
| Vowel (i vs. u) | 0.27711 | 0.07238 | 3.829 | **<0.001** |
| Place (labial vs. coronal) | 0.09636 | 0.05921 | 1.627 | 0.106 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Vowel u /coronal | 3.2571 | 0.28598 | 11.389 | **<0.001** |
| Vowel (i vs. u) | -0.27711 | 0.07238 | -3.829 | **<0.001** |
| Vowel (ɨ vs. u) | -0.23285 | 0.07238 | -3.217 | **0.002** |
| Place (labial vs. coronal) | 0.09636 | 0.05921 | 1.627 | 0.106 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.7048 | 0.8395 |  |
| Residual |  | 0.1336 | 0.3655 |  |

Table A4 Prompt lists

|  |  |  |  |
| --- | --- | --- | --- |
| phonemic transcription | Polish | Ukrainian | Russian |
| /p/+/i/ | Pipip | Пiпi | Пипи |
| / ɕ, t͡ɕ /+/i/ | Sisiś, Cicić | Чiчi, Шiшi | Щищи, Чичи |
| /ʂ, t͡ʂ/+/i/ | Sziszisz, Cziczicz |  |
| /t/+/i/ | Titit | Тiтi | Тити |
| /k/+/i/ | Kikik | Кiкi | Кики |
| /x/+/i/  |  | Хiхi |  |
| /p/+/ɨ/ | Pypyp | Пипи | Пыпы |
| / ʂ, t͡ʂ/+/ɨ/ | Szyszysz, Czyczycz | Чичи, Шiшi | Шиши |
| /t/+/ɨ/ | Tytyt | Тити | Тыты |
| /k/+/ɨ/ | Kykyk | Кики |  |
| /x/+/ɨ/ |  | Хихи |  |
| /p/+/e/ | Pepep | Пепе | Пепе |
| / ɕ, t͡ɕ/+/e/ | Siesieś, Ciecieć |  | Щeщe, Чeчe |
| /ʂ t͡ʂ/+/e/ | Szeszesz, Czeczecz | Чeчe, Шеше | Шеше |
| /t/+/e/ | Tetet | Тете | Тете |
| /k/+/e/ | Kekek | Кеке | Кеке |
| /x/+/e/ |  | Xeхе |  |
| /p/+/a/ | Papap | Папа | Папа |
| / pʲ/+/a/ |  | Пяпя | Пяпя |
| /ɕ, t͡ɕ/+/a/ | Siasiaś, Ciaciać | Чача, Шаша | Щaщa, Чача |
| /ʂ t͡ʂ/+/a/ | Szaszasz, Czaczacz | Шаша |
| /t/+/a/ | Tatat | Тата | Тата |
| /tʲ/+/a/ |  | Тятя | Тятя |
| /k/+/a/ | Kakak | Кака | Кака |
| /kʲ/+/a/ |  | Кякя | Кякя |
| /x/+/a/ |  | хаха |  |
| /p/+/o/ | Popop | Попо | Попо |
| / pʲ/+/o/ |  |  | Пёпё |
| /ɕ, t͡ɕ/+/o/ | Siosioś, Ciocioć |  | Щёщё, Чёчо |
| /ʂ t͡ʂ/+/o/ | Szoszosz, czoczocz | Чoчo, Шoшo | Шoшo |
| /t/+/o/ | Totot | Тото | Тото |
| / tʲ/+/o/ |  |  | Тётё |
| /k/+/o/ | Kokok | Коко | Коко |
| /kʲ/+/o/ |  |  | Кёкё |
| /x/+/o/ |  | Xохо |  |
| /p/+/u/ | Pupup | Пупу | Пупу |
| /pʲ/+/u/ |  | Пюпю | Пюпю |
| /ɕ, t͡ɕ/+/u/ | Siusiuś, Ciuciuć |  | Щущу, Чучу |
| /ʂ t͡ʂ/+/u/ | Szuszusz, Czuczucz | Чучу, Шушу | Шушу |
| /t/+/u/ | Tutut | Туту | Туту |
| /tʲ/+/u/ |  | Тютю | Тютю |
| /k/+/u/ | Kukuk | Куку | Куку |
| /kʲ/+/u/ |  | Кюкю | Кюкю |
| /x/+/u/ |  | Хуху |  |

Table A5 The impact of the dialect

|  |
| --- |
| Polish /ɨ/ |
| Dialect pairs | Tongue root frontness of /ɨ/ | Tongue root height of /ɨ/ | Dorsum frontness /ɨ/ | Dorsum height |
| Central ~ South-East | **p=0.030** | p=0.693 | p=0.356 | **p=0.009** |

|  |
| --- |
| Russian /ɨ/ |
| Dialect pairs | Tongue root frontness of /ɨ/ | Tongue root height  | Dorsum frontness  | Dorsum height |
| North~Central | p=0.315 | p=0.570 | p=0.193 | p=0.171 |
| South~Central | p=0.640 | p=1 | p=0.788 | p=0.145 |
| North~South | p=0.454 | p=0.594 | p=0.123 | p=0.637 |

|  |
| --- |
| Ukrainian /ɨ/ |
| Dialect pairs | Tongue root frontness of /ɨ/ | Tongue root height of /ɨ/ | Dorsum frontness | Dorsum height of  |
| East~West | p=0.075 | p=0.376 | p=0.350 | p=0.570 |

Table A5.1 Polish dialects

|  |
| --- |
| Fronting for Tongue Root (xTR) for Polish Dialects for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Central /coronal | -2.892754 | 0.225763 | -12.813 | **<0.001** |
| Dialect (Central vs. South-East) | -1.454732 | 0.629467 | -2.311 | **0.03** |
| Place (labial vs. coronal) | 0.001803 | 0.110053 | 0.016 | 0.987 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.3059 | 0.5531 |  |
| Residual |  | 0.08478 | 0.2912 |  |

|  |
| --- |
| Raising for Tongue Root (yTR) for Polish Dialects for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Central /coronal | -1.3807 | 0.27421 | -5.035 | **<0.001** |
| Dialect (Central vs. South-East) | 0.29549 | 0.73994 | 0.399 | 0.693 |
| Place (labial vs. coronal) | 0.04023 | 0.26651 | 0.151 | 0.881 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.2415 | 0.4914 |  |
| Residual |  | 0.4972 | 0.7051 |  |

|  |
| --- |
| Fronting for Tongue Dorsum (xTB) for Polish Dialects for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Central /coronal | 1.9052 | 0.1688 | 11.285 | **<0.001** |
| Dialect (Central vs. South-East) | 0.4363 | 0.4627 | 0.943 | 0.356 |
| Place (labial vs. coronal) | 0.1734 | 0.1259 | 1.378 | 0.182 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.1341 | 0.3662 |  |
| Residual |  | 0.1109 | 0.3331 |  |

|  |
| --- |
| Raising for Tongue Dorsum (yTB) for Polish Dialects for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Central /coronal | 2.55726 | 0.19421 | 13.167 | **<0.001** |
| Dialect (Central vs. South-East) | 1.55474 | 0.54151 | 2.871 | **0.009** |
| Place (labial vs. coronal) | 0.04789 | 0.09461 | 0.506 | 0.618 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.22642 | 0.4758 |  |
| Residual |  | 0.06266 | 0.2503 |  |

Table A5.2 Ukrainian dialects

|  |
| --- |
| Fronting for Tongue Root (xTR) for Ukrainian Dialects for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - East /coronal | -2.9862 | 0.3182 | -9.385 | **<0.001** |
| Dialect (East vs. West) | 0.8359 | 0.4533 | 1.844 | 0.075 |
| Place (labial vs. coronal) | -0.2067 | 0.2056 | -1.005 | 0.323 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.3622 | 0.6019 |  |
| Residual |  | 0.3671 | 0.6059 |  |

|  |
| --- |
| Raising for Tongue Root (yTR) for Ukrainian Dialects for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - East /coronal | -0.2333 | 0.6594 | -0.354 | 0.726 |
| Dialect (East vs. West) | -0.8599 | 0.9561 | -0.899 | 0.376 |
| Place (labial vs. coronal) | -0.1979 | 0.3494 | -0.566 | 0.575 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 1.759 | 1.326 |  |
| Residual |  | 1.059 | 1.029 |  |

|  |
| --- |
| Fronting for Tongue Dorsum (xTB) for Ukrainian Dialects for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - East /coronal | 0.55221 | 0.64469 | 0.857 | 0.398 |
| Dialect (East vs. West) | 0.55221 | 0.94746 | 0.95 | 0.35 |
| Place (labial vs. coronal) | -0.07566 | 0.26703 | -0.283 | 0.779 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 1.8356 | 1.3548 |  |
| Residual |  | 0.6184 | 0.7864 |  |

|  |
| --- |
| Raising for Tongue Dorsum (yTB) for Ukrainian Dialects for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - East /coronal | 2.68295 | 0.5402 | 4.967 | **<0.001**  |
| Dialect (East vs. West) | -0.54159 | 0.80636 | -0.672 | 0.507 |
| Place (labial vs. coronal) | 0.03656 | 0.11016 | 0.332 | 0.742 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 1.4178 | 1.1907 |  |
| Residual |  | 0.1052 | 0.3243 |  |

Table A5.3 Russian dialects

|  |
| --- |
| Fronting for Tongue Root (xTR) for Russian Dialects for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Central /coronal | -2.9237 | 0.6683 | -4.375 | **<0.001** |
| Dialect (Central vs. North) | -1.3462 | 1.3254 | -1.016 | 0.315 |
| Dialect (Central vs. South) | -0.3958 | 0.8395 | -0.471 | 0.64 |
| Place (labial vs. coronal) | -0.5321 | 0.1715 | -3.103 | **0.003** |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - North /coronal | -4.2699 | 1.1506 | -3.711 | **0.001** |
| Dialect (North vs. South) | 0.9505 | 1.2574 | 0.756 | 0.454 |
| Dialect (North vs. Central) | 1.3462 | 1.3254 | 1.016 | 0.315 |
| Place (labial vs. coronal) | -0.5321 | 0.1715 | -3.103 | **0.003** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 1.2542 | 1.1199 |  |
| Residual |  | 0.3736 | 0.6112 |  |

|  |
| --- |
| Raising for Tongue Root (yTR) for Russian Dialects for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Central /coronal | -0.339 | 0.3141 | -1.079 | 0.286 |
| Dialect (Central vs. North) | 0.3323 | 0.5804 | 0.572 | 0.57 |
| Dialect (Central vs. South) | 0.0000094 | 0.3719 | 0 | 1 |
| Place (labial vs. coronal) | -0.1574 | 0.2391 | -0.658 | 0.514 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - North /coronal | -0.006782 | 0.5148 | -0.013 | 0.99 |
| Dialect (North vs. South) | -0.33225 | 0.550361 | -0.604 | 0.549 |
| Dialect (North vs. Central) | -0.332259 | 0.580416 | -0.572 | 0.57 |
| Place (labial vs. coronal) | -0.1574 | 0.2391 | -0.658 | 0.514 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.1295 | 0.3599 |  |
| Residual |  | 0.7274 | 0.8529 |  |

|  |
| --- |
| Fronting for Tongue Dorsum (xTB) for Russian Dialects for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Central /coronal | 1.0065 | 0.4083 | 2.465 | **0.018** |
| Dialect (Central vs. North) | -1.0514 | 0.7962 | -1.321 | 0.193 |
| Dialect (Central vs. South) | 0.1369 | 0.5058 | 0.271 | 0.788 |
| Place (labial vs. coronal) | -0.462 | 0.1808 | -2.556 | **0.014** |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - North /coronal | -0.04489 | 0.69459 | -0.065 | 0.949 |
| Dialect (North vs. South) | 1.18828 | 0.75528 | 1.573 | 0.123 |
| Dialect (North vs. Central) | 1.05139 | 0.7962 | 1.321 | 0.193 |
| Place (labial vs. coronal) | -0.462 | 0.1808 | -2.556 | **0.014** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.4051 | 0.6365 |  |
| Residual |  | 0.4153 | 0.6444 |  |

|  |
| --- |
| Raising for Tongue Dosrum (yTB) for Russian Dialects for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - Central /coronal | 2.31953 | 0.51615 | 4.494 | **<0.001** |
| Dialect (Central vs. North) | 1.43048 | 1.02825 | 1.391 | 0.171 |
| Dialect (Central vs. South) | 0.96642 | 0.65077 | 1.485 | 0.145 |
| Place (labial vs. coronal) | 0.12091 | 0.09074 | 1.332 | 0.189 |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - North /coronal | 2.31953 | 0.51615 | 4.494 | **<0.001** |
| Dialect (North vs. South) | 1.43048 | 1.02825 | 1.391 | 0.637 |
| Dialect (North vs. Central) | 0.96642 | 0.65077 | 1.485 | 0.171 |
| Place (labial vs. coronal) | 0.12091 | 0.09074 | 1.332 | 0.189 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.7753 | 0.8805 |  |
| Residual |  | 0.1046 | 0.3234 |  |

Table A6 The impact of English as L2. Vowel /ɨ/ in participants with shorter duration of stay in the United States (≤1 year) and the participants with a longer duration of stay in the United States (>1 year)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Language\dimension | Tongue root frontness | Tongue root height | Dorsum frontness | Dorsum height |
| Polish “new” immigrants versus “old” immigrants | p=0.185 | p=0.126 | p=0.110 | p=0.985 |
| Russian “new” immigrants versus “old” immigrants | p=0.187 | p=0.541 | **p=0.029** | **p=0.037** |
| Ukrainian “new” immigrants versus “old” immigrants | **p<0.001** | **p=0.003** | **p=0.007** | p=0.695 |

Table A6.1 Polish participants

|  |
| --- |
| Fronting for Tongue Root (xTR) for Polish Length of Stay for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - New /coronal | -4.164364 | 0.727772 | -5.722 | **<0.001** |
| Length of Stay (New vs. Old) | 1.110338 | 0.823374 | 1.349 | 0.185 |
| Place (labial vs. coronal) | 0.009888 | 0.115344 | 0.086 | 0.932 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 1.0283 | 1.014 |  |
| Residual |  | 0.1463 | 0.3826 |  |

|  |
| --- |
| Raising for Tongue Root (yTR) for Polish Length of Stay for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - New /coronal | -0.38884 | 0.56121 | -0.693 | 0.493 |
| Length of Stay (New vs. Old) | -0.98524 | 0.62986 | -1.564 | 0.126 |
| Place (labial vs. coronal) | 0.03532 | 0.1893 | 0.187 | 0.853 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.5463 | 0.7391 |  |
| Residual |  | 0.3942 | 0.6278 |  |

|  |
| --- |
| Fronting for Tongue Dorsum (xTB) for Polish Length of Stay for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - New /coronal | 1.1502 | 0.3932 | 2.925 | **0.006** |
| Length of Stay (New vs. Old) | 0.7219 | 0.4411 | 1.637 | 0.11 |
| Place (labial vs. coronal) | 0.2136 | 0.1349 | 1.584 | 0.121 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.2667 | 0.5164 |  |
| Residual |  | 0.2001 | 0.4474 |  |

|  |
| --- |
| Raising for Tongue Dorsum (yTB) for Polish Length of Stay for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - New /coronal | 2.50686 | 0.52791 | 4.749 | **<0.001** |
| Length of Stay (New vs. Old) | 0.01096 | 0.59117 | 0.019 | 0.985 |
| Place (labial vs. coronal) | 0.23056 | 0.19612 | 1.176 | 0.247 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.4676 | 0.6838 |  |
| Residual |  | 0.4231 | 0.6505 |  |

Table A6.2 The impact of English as L2: Ukrainian participants

|  |
| --- |
| Fronting for Tongue Root (xTR) for Ukrainian Length of Stay for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - New /coronal | -3.3054 | 0.2414 | -13.693 | **<0.001** |
| Length of Stay (New vs. Old) | 1.2432 | 0.2951 | 4.213 | **<0.001** |
| Place (labial vs. coronal) | -0.1879 | 0.2051 | -0.916 | 0.367 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.09944 | 0.3153 |  |
| Residual |  | 0.36624 | 0.6052 |  |

|  |
| --- |
| Raising for Tongue Root (yTR) for Ukrainian Length of Stay for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - New /coronal | 0.5293 | 0.5114 | 1.035 | 0.309 |
| Length of Stay (New vs. Old) | -2.0608 | 0.6476 | -3.182 | **0.003** |
| Place (labial vs. coronal) | -0.2094 | 0.3486 | -0.601 | 0.553 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.6604 | 0.8126 |  |
| Residual |  | 1.0562 | 1.0277 |  |

|  |
| --- |
| Fronting for Tongue Dorsum (xTB) for Ukrainian Length of Stay for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - New /coronal | -0.14315 | 0.52257 | -0.274 | 0.786 |
| Length of Stay (New vs. Old) | 1.97176 | 0.67939 | 2.902 | **0.007** |
| Place (labial vs. coronal) | -0.06803 | 0.26673 | -0.255 | 0.8 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.8668 | 0.931 |  |
| Residual |  | 0.6175 | 0.7858 |  |

|  |
| --- |
| Raising for Tongue Dorsum (yTB) for Ukrainian Length of Stay for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - New /coronal | 2.62301 | 0.6154 | 4.262 | **<0.001** |
| Length of Stay (New vs. Old) | -0.32538 | 0.82255 | -0.396 | 0.695 |
| Place (labial vs. coronal) | 0.03612 | 0.11017 | 0.328 | 0.745 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 1.4764 | 1.2151 |  |
| Residual |  | 0.1052 | 0.3244 |  |

Table A6.3 The impact of English as L2: Russian participants

|  |
| --- |
| Fronting for Tongue Root (xTR) for Russian Length of Stay for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - New /coronal | -2.4392 | 0.7293 | -3.345 | **0.002** |
| Length of Stay (New vs. Old) | -1.1001 | 0.8217 | -1.339 | 0.187 |
| Place (labial vs. coronal) | -0.5334 | 0.1716 | -3.109 | **0.003** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.9866 | 0.9933 |  |
| Residual |  | 0.3739 | 0.6115 |  |

|  |
| --- |
| Raising for Tongue Root (yTR) for Russian Length of Stay for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - New /coronal | -0.4782 | 0.349 | -1.37 | 0.177 |
| Length of Stay (New vs. Old) | 0.2303 | 0.3738 | 0.616 | 0.541 |
| Place (labial vs. coronal) | -0.1545 | 0.2392 | -0.646 | 0.521 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.0937 | 0.3061 |  |
| Residual |  | 0.7279 | 0.8532 |  |

|  |
| --- |
| Fronting for Tongue Dorsum (xTB) for Russian Length of Stay for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - New /coronal | 1.78 | 0.4185 | 4.254 | **<0.001** |
| Length of Stay (New vs. Old) | -1.0493 | 0.4643 | -2.26 | **0.029** |
| Place (labial vs. coronal) | -0.465 | 0.1806 | -2.575 | **0.013** |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.2648 | 0.5146 |  |
| Residual |  | 0.4146 | 0.6439 |  |

|  |
| --- |
| Raising for Tongue Dorsum (yTB) for Russian Length of Stay for /ɨ/ |
| Predictor | Estimate | SE | t-value | p-value |
| (Intercept) - New /coronal | 1.96563 | 0.55477 | 3.543 | **0.001** |
| Length of Stay (New vs. Old) | 1.35006 | 0.62714 | 2.153 | **0.037** |
| Place (labial vs. coronal) | 0.12194 | 0.09073 | 1.344 | 0.186 |
| Random effects |
| Groups | Name | Variance | Standard Deviation |  |
| Speaker | (Intercept) | 0.594 | 0.7707 |  |
| Residual |  | 0.1046 | 0.3234 |  |