A Comprehensive Analysis of
Static Word Embeddings for Turkish

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Detailed Intrinsic Analysis Results

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In the analogy tasks results for verb and noun conjugation suffixes, Güngör *et al.*'s (2017) research served as a major source of inspiration. Their work played a crucial role in developing our models, laying a strong foundation for our approach and providing a benchmark Mean Reciprocal Rank (MRR) for comparison.

Morphological Categories	Number of examples	Top-N Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.288	0.439	0.339	29.68%
2. tekil kişi çekimi.txt	946	0.411	0.323	0.365	-11.48%
2. çoğul kişi çekimi.txt	946	0.349	0.398	0.327	21.94%
3. çoğul kişi çekimi.txt	1128	0.419	0.372	0.42	-11.22%
emir kipi.txt	1176	0.187	0.632	0.465	36.06%
gelecek zaman kipi.txt	1176	0.105	0.801	0.707	13.37%
gereklilik kipi.txt	1128	0.232	0.561	0.467	20.19%
geçmiş zaman eki (-di).txt	1176	0.225	0.622	0.535	16.25%
geçmiş zaman eki (-miş).txt	1176	0.088	0.799	0.774	3.32%
istek kipi.txt	1176	0.249	0.582	0.534	8.97%
olumsuzluk eki.txt	1176	0.137	0.642	0.67	-4.08%
şimdiki zaman eki (-mekte).txt	1176	0.132	0.749	0.646	15.99%
şimdiki zaman eki (-yor).txt	861	0.077	0.874	0.847	3.26%
Overall	14231	0.220	0.604	0.549	10.02%

Table 1: *Fiil çekim ekleri*: MRR Result Comparison for **Word2Vec** with 5 epochs

Semantic Categories	Number of examples	Top-N Miss Ratio	MRR
Aile	90	0.289	0.526
Para birimi	156	0.730	0.149
Şehir-bölge	1344	0.092	0.605
Ülke-başkent	506	0.081	0.656
Eş anlamlılar	600	0.4	0.467
Zıt anlamlılar	600	0.336	0.448
Overall	3296	0.226	0.535

Table 2: *Semantic categories*: MRR Results of **Word2Vec** with 5 epochs

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 83.80	p-value: 6.83×10^{-21}
	Spearman Result: 82.57	p-value: 7.98×10^{-20}
	OOV Ratio: 46.42	
Semantic Similarity	Pearson Result: 70.72	p-value: 6.38×10^{-57}
	Spearman Result: 74.33	p-value: 9.93×10^{-66}
	OOV Ratio: 26.6	

Table 3: Similarity test results for **Word2Vec** with 5 epochs ($p \times 100$)

Morphological Categories	Number of examples	Top-N Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
Şimdiki zaman eki (-yor)	861	0.067	0.884	0.847	4.37%
geçmiş zaman eki (-miş)	1176	0.086	0.808	0.774	4.39%
Gelecek zaman eki	1176	0.109	0.792	0.707	12.05%
Olumsuzluk eki	1176	0.136	0.651	0.67	-2.83%
Şimdiki zaman eki (-mekte)	1176	0.115	0.760	0.646	17.65%
Geçmiş zaman eki (-di)	1176	0.220	0.633	0.535	18.32%
İstek kipi	1176	0.237	0.593	0.534	11.02%
Gereklilik kipi	1128	0.238	0.575	0.467	23.10%
Emir kipi	1176	0.193	0.643	0.465	38.29%
3. çoğul kişi çekimi	1128	0.392	0.388	0.42	-7.61%
2. tekil kişi çekimi	946	0.426	0.315	0.365	-13.70%
1. tekil kişi çekimi	990	0.311	0.426	0.339	25.66%
2. çoğul kişi çekimi	946	0.358	0.380	0.327	16.20%
Overall	14231	0.219	0.609	0.549	10.96%

Table 4: *Fiil çekim ekleri*: MRR Result Comparison for **Word2Vec** with 10 epochs

Morphological Categories	Number of examples	Top-N Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.502	0.30	0.238	26.26%
-e eki.txt	1176	0.516	0.271	0.236	14.92%
1. tekil kişi iyelik.txt	1128	0.640	0.221	0.148	49.60%
1. çoğul kişi iyelik.txt	1128	0.505	0.343	0.25	37.44%
2. tekil kişi iyelik.txt	1176	0.568	0.317	0.321	-1.13%
2. çoğul kişi iyelik.txt	1081	0.555	0.299	0.196	52.75%
3. tekil kişi iyelik eki.txt	1176	0.321	0.437	0.448	-2.37%
3. çoğul kişi iyelik.txt	1128	0.484	0.228	0.178	28.40%
eşitlik eki (-ce).txt	276	0.945	0.0345	0.027	27.84%
ismin -de hali.txt	1128	0.709	0.137	0.136	0.83%
ismin -i hali.txt	1176	0.337	0.439	0.439	0.18%
tamlayan eki.txt	1176	0.275	0.539	0.488	10.61%
vasıta eki (-le).txt	1128	0.454	0.337	0.253	33.32%
Overall	14005	0.510	0.318	0.274	16.11%

Table 5: *İsim çekim ekleri*: MRR Result Comparison for **Word2Vec** with 5 epochs

Morphological Categories	Number of examples	Top-N Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
Tamlayan eki	1176	0.252	0.548	0.488	12.30%
3. tekil kişi iyelik eki	1176	0.292	0.467	0.448	4.24%
İsmin -i hali	1176	0.325	0.454	0.439	3.42%
2. tekil kişi iyelik eki	1176	0.552	0.322	0.321	0.31%
Vasıta eki (-le)	1128	0.437	0.355	0.253	40.16%
1. çoğul kişi iyelik eki	1128	0.498	0.358	0.25	43.2%
-den eki	1128	0.481	0.316	0.238	32.77%
-e eki	1176	0.480	0.293	0.236	23.98%
2. çoğul kişi iyelik eki	1081	0.546	0.288	0.196	46.88%
3. çoğul kişi iyelik eki	1128	0.466	0.245	0.178	37.64%
1. tekil kişi iyelik eki	1128	0.654	0.216	0.148	45.95%
İsmin -de hali	1128	0.683	0.148	0.136	8.70%
Eşitlik eki (-ce)	276	0.956	0.028	0.027	3.70%
Overall	14005	0.479	0.329	0.273	20.51%

Table 6: *İsim çekim ekleri*: MRR Result Comparison for **Word2Vec** with 10 epochs

Semantic Categories	Number of examples	Top-N Miss Ratio	MRR
Aile	90	0.256	0.571
Para birimi	156	0.724	0.181
Şehir-bölge	1344	0.083	0.622
Ülke-başkent	506	0.045	0.683
Eş anlamlılar	600	0.385	0.476
Zıt anlamlılar	600	0.323	0.452
Overall	3296	0.210	0.551

Table 7: *Semantic categories*: MRR Results of **Word2Vec** with 10 epochs

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 82.53	p-value: 8.56 x 10^{-20}
	Spearman Result: 81.68	p-value: 4.11 x 10^{-19}
	OOV Ratio: 46.42	
Semantic Similarity	Pearson Result: 70.77	p-value: 4.77 x 10^{-57}
	Spearman Result: 74.57	p-value: 2.36 x 10^{-66}
	OOV Ratio: 26.6	

Table 8: Similarity test results for **Word2Vec** with 10 epochs ($p \times 100$)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.797	0.105	0.339	-69.03%
2. tekil kişi çekimi.txt	946	0.877	0.059	0.365	-83.84%
2. çoğul kişi çekimi.txt	946	0.851	0.085	0.327	-74.01%
3. çoğul kişi çekimi.txt	1128	0.803	0.105	0.42	-75.0%
emir kipi.txt	1176	0.656	0.21	0.465	-54.84%
gelecek zaman kipi.txt	1176	0.39	0.437	0.707	-38.19%
gereklilik kipi.txt	1128	0.632	0.212	0.467	-54.6%
geçmiş zaman eki (-di).txt	1176	0.4	0.428	0.535	-20.0%
geçmiş zaman eki (-miş).txt	1176	0.332	0.483	0.774	-37.6%
istek kipi.txt	1176	0.577	0.235	0.534	-55.99%
olumsuzluk eki.txt	1176	0.578	0.248	0.67	-62.99%
şimdiki zaman eki (-mekte).txt	1176	0.431	0.328	0.646	-49.23%
şimdiki zaman eki (-yor).txt	861	0.084	0.806	0.847	-4.84%
Overall	14231	0.567	0.287	0.549	-47.81%

Table 9: *Fiil çekim ekleri*: MRR Result Comparison for **left-aligned Word2Vec** with 10 epochs

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.727	0.148	0.238	-37.82%
-e eki.txt	1176	0.708	0.143	0.236	-39.41%
1. tekil kişi iyelik.txt	1128	0.768	0.123	0.148	-16.89%
1. çoğul kişi iyelik.txt	1128	0.596	0.254	0.25	1.6%
2. tekil kişi iyelik.txt	1176	0.634	0.229	0.321	-28.66%
2. çoğul kişi iyelik.txt	1081	0.693	0.182	0.196	-7.14%
3. tekil kişi iyelik eki.txt	1176	0.268	0.507	0.448	13.17%
3. çoğul kişi iyelik.txt	1128	0.549	0.196	0.178	10.11%
eşitlik eki (-ce).txt	276	0.967	0.018	0.027	-33.33%
ismin -de hali.txt	1128	0.832	0.073	0.136	-46.32%
ismin -i hali.txt	1176	0.341	0.431	0.439	-1.82%
tamlayan eki.txt	1176	0.352	0.411	0.488	-15.78%
vasıta eki (-le).txt	1128	0.679	0.164	0.253	-35.18%
Overall	14005	0.6	0.236	0.275	-14.09%

Table 10: *İsim çekim ekleri*: MRR Result Comparison for **left-aligned Word2Vec** with 10 epochs

Morphological Categories	Number of examples	Topn Miss Ratio	MRR
aile.txt	90	0.311	0.544
es-anlamlilar.txt	600	0.417	0.408
para-birimi.txt	156	0.788	0.157
sehir-bolge.txt	1344	0.085	0.617
zit-anlamlilar.txt	600	0.363	0.432
ülke-başkent.txt	506	0.067	0.703
Overall	3296	0.233	0.535

Table 11: *Semantic categories*: MRR Results of **left-aligned Word2Vec** with 10 epochs

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 79.05	p-value: 3.31 x 10^{-17}
	Spearman Result: 79.42	p-value: 1.85 x 10^{-17}
	OOV Ratio: 46.42	
Semantic Similarity	Pearson Result: 69.85	p-value: 5.20 x 10^{-55}
	Spearman Result: 73.98	p-value: 8.60 x 10^{-65}
	OOV Ratio: 26.6	

Table 12: Similarity test results for **left-aligned Word2Vec** with 10 epochs ($p \times 100$)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.323	0.418	0.339	23.3%
2. tekil kişi çekimi.txt	946	0.426	0.31	0.365	-15.07%
2. çoğul kişi çekimi.txt	946	0.316	0.41	0.327	25.38%
3. çoğul kişi çekimi.txt	1128	0.394	0.412	0.42	-1.9%
emir kipi.txt	1176	0.183	0.634	0.465	36.34%
gelecek zaman kipi.txt	1176	0.116	0.733	0.707	3.68%
gereklilik kipi.txt	1128	0.227	0.572	0.467	22.48%
geçmiş zaman eki (-di).txt	1176	0.242	0.586	0.535	9.53%
geçmiş zaman eki (-miş).txt	1176	0.117	0.677	0.774	-12.53%
istek kipi.txt	1176	0.319	0.477	0.534	-10.67%
olumsuzluk eki.txt	1176	0.122	0.668	0.67	-0.3%
şimdiki zaman eki (-mekte).txt	1176	0.334	0.391	0.646	-39.47%
şimdiki zaman eki (-yor).txt	861	0.072	0.863	0.847	1.89%
Overall	14231	0.244	0.551	0.549	0.43%

Table 13: *Fiil çekim ekleri*: MRR Result Comparison for **right-aligned Word2Vec** with 10 epochs

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.588	0.163	0.238	-31.51%
-e eki.txt	1176	0.361	0.317	0.236	34.32%
1. tekil kişi iyelik.txt	1128	0.738	0.154	0.148	4.05%
1. çoğul kişi iyelik.txt	1128	0.559	0.293	0.25	17.2%
2. tekil kişi iyelik.txt	1176	0.581	0.303	0.321	-5.61%
2. çoğul kişi iyelik.txt	1081	0.699	0.173	0.196	-11.73%
3. tekil kişi iyelik eki.txt	1176	0.298	0.394	0.448	-12.05%
3. çoğul kişi iyelik.txt	1128	0.579	0.148	0.178	-16.85%
eşitlik eki (-ce).txt	276	0.957	0.021	0.027	-22.22%
ismin -de hali.txt	1128	0.649	0.137	0.136	0.74%
ismin -i hali.txt	1176	0.262	0.421	0.439	-4.1%
tamlayan eki.txt	1176	0.259	0.513	0.488	5.12%
vasıta eki (-le).txt	1128	0.547	0.206	0.253	-18.58%
Overall	14005	0.515	0.266	0.275	-3.19%

Table 14: *İsim çekim ekleri*: MRR Result Comparison for **right-aligned Word2Vec** with 10 epochs

Morphological Categories	Number of examples	Topn Miss Ratio	MRR
aile.txt	90	0.367	0.454
es-anlamlilar.txt	600	0.492	0.348
para-birimi.txt	156	0.75	0.18
sehir-bolge.txt	1344	0.158	0.51
zit-anlamlilar.txt	600	0.39	0.457
ülke-başkent.txt	506	0.16	0.572
Overall	3296	0.295	0.463

Table 15: *Semantic categories*: MRR Results of **right-aligned Word2Vec** with 10 epochs

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 79.02	p-value: 3.50×10^{-17}
	Spearman Result: 76.72	p-value: 9.95×10^{-16}
	OOV Ratio: 46.42	
Semantic Similarity	Pearson Result: 70.11	p-value: 1.47×10^{-55}
	Spearman Result: 73.17	p-value: 9.61×10^{-63}
	OOV Ratio: 26.6	

Table 16: Similarity test results for **right-aligned Word2Vec** with 10 epochs ($p \times 100$)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.293	0.432	0.339	27.43%
2. tekil kişi çekimi.txt	946	0.452	0.298	0.365	-18.36%
2. çoğul kişi çekimi.txt	946	0.364	0.386	0.327	18.04%
3. çoğul kişi çekimi.txt	1128	0.375	0.394	0.42	-6.19%
emir kipi.txt	1176	0.193	0.627	0.465	34.84%
gelecek zaman kipi.txt	1176	0.105	0.781	0.707	10.47%
gereklilik kipi.txt	1128	0.247	0.561	0.467	20.13%
geçmiş zaman eki (-di).txt	1176	0.218	0.629	0.535	17.57%
geçmiş zaman eki (-miş).txt	1176	0.088	0.805	0.774	4.01%
istek kipi.txt	1176	0.22	0.599	0.534	12.17%
olumsuzluk eki.txt	1176	0.139	0.647	0.67	-3.43%
şimdiki zaman eki (-mekte).txt	1176	0.116	0.769	0.646	19.04%
şimdiki zaman eki (-yor).txt	861	0.064	0.889	0.847	4.96%
Overall	14231	0.217	0.606	0.549	10.44%

Table 17: *Fiil çekim ekleri*: MRR Results of **Word2Vec** with 15 epochs

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.473	0.335	0.238	40.76%
-e eki.txt	1176	0.458	0.307	0.236	30.08%
1. tekil kişi iyelik.txt	1128	0.614	0.24	0.148	62.16%
1. çoğul kişi iyelik.txt	1128	0.481	0.361	0.25	44.4%
2. tekil kişi iyelik.txt	1176	0.552	0.32	0.321	-0.31%
2. çoğul kişi iyelik.txt	1081	0.551	0.283	0.196	44.39%
3. tekil kişi iyelik eki.txt	1176	0.27	0.484	0.448	8.04%
3. çoğul kişi iyelik.txt	1128	0.477	0.235	0.178	32.02%
eşitlik eki (-ce).txt	276	0.949	0.031	0.027	14.81%
ismin -de hali.txt	1128	0.65	0.162	0.136	19.12%
ismin -i hali.txt	1176	0.313	0.464	0.439	5.69%
tamlayan eki.txt	1176	0.256	0.547	0.488	12.09%
vasıta eki (-le).txt	1128	0.427	0.361	0.253	42.69%
Overall	14005	0.468	0.337	0.275	22.67%

Table 18: *İsim çekim ekleri*: MRR Results of **Word2Vec** with 15 epochs

Morphological Categories	Number of examples	Topn Miss Ratio	MRR
aile.txt	90	0.244	0.59
es-anlamlilar.txt	600	0.382	0.468
para-birimi.txt	156	0.692	0.2
sehir-bolge.txt	1344	0.089	0.617
zit-anlamlilar.txt	600	0.332	0.458
ülke-başkent.txt	506	0.04	0.712
Overall	3296	0.212	0.555

Table 19: *Semantic categories*: MRR Results of **Word2Vec** with 15 epochs

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 81.54	p-value: 5.29 x 10^{-19}
	Spearman Result: 81.83	p-value: 3.14 x 10^{-19}
	OOV Ratio: 46.42	
Semantic Similarity	Pearson Result: 70.67	p-value: 5.33 x 10^{-57}
	Spearman Result: 74.53	p-value: 2.98 x 10^{-66}
	OOV Ratio: 26.6	

Table 20: Similarity test results for **Word2Vec** with 15 epochs

Morphological Categories	Number of examples	Top-N Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.087	0.675	0.339	99.16%
2. tekil kişi çekimi.txt	946	0.086	0.718	0.365	96.66%
2. çoğul kişi çekimi.txt	946	0.076	0.763	0.327	133.39%
3. çoğul kişi çekimi.txt	1128	0.277	0.621	0.42	47.99%
emir kipi.txt	1176	0.219	0.622	0.465	33.81%
gelecek zaman kipi.txt	1176	0.034	0.883	0.707	24.89%
gereklilik kipi.txt	1128	0.192	0.640	0.467	37.12%
geçmiş zaman eki (-di).txt	1176	0.256	0.589	0.535	10.16%
geçmiş zaman eki (-miş).txt	1176	0.080	0.759	0.774	-1.83%
istek kipi.txt	1176	0.161	0.559	0.534	4.76%
olumsuzluk eki.txt	1176	0.108	0.776	0.67	15.86%
şimdiki zaman eki (-mekte).txt	1176	0.058	0.884	0.646	36.91%
şimdiki zaman eki (-yor).txt	861	0.059	0.883	0.847	4.33%
Overall	14231	0.133	0.718	0.549	30.78%

Table 21: *Fiil çekim ekleri*: MRR Result Comparison for **FastText** with 5 epochs

Morphological Categories	Number of examples	Top-N Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.453	0.331	0.238	39.11%
-e eki.txt	1176	0.553	0.251	0.236	6.60%
1. tekil kişi iyelik.txt	1128	0.432	0.349	0.148	136.31%
1. çoğul kişi iyelik.txt	1128	0.295	0.512	0.25	105.19%
2. tekil kişi iyelik.txt	1176	0.482	0.339	0.321	5.91%
2. çoğul kişi iyelik.txt	1081	0.218	0.594	0.196	203.54%
3. tekil kişi iyelik eki.txt	1176	0.468	0.312	0.448	-30.20%
3. çoğul kişi iyelik.txt	1128	0.483	0.257	0.178	44.40%
eşitlik eki (-ce).txt	276	0.822	0.0747	0.027	176.77%
ismin -de hali.txt	1128	0.605	0.188	0.136	38.93%
ismin -i hali.txt	1176	0.458	0.332	0.439	-24.28%
tamlayan eki.txt	1176	0.276	0.515	0.488	5.56%
vasıta eki (-le).txt	1128	0.356	0.425	0.253	68.20%
Overall	14005	0.432	0.360	0.27	33.33%

Table 22: *İsim çekim ekleri*: MRR Result Comparison for **FastText** with 5 epochs

Semantic Categories	Number of examples	Top-N Miss Ratio	MRR
Aile	90	0.422	0.312
Para birimi	156	0.852	0.055
Şehir-bölge	1344	0.645	0.186
Ülke-başkent	506	0.193	0.548
Eş anlamlılar	600	0.611	0.243
Zıt anlamlılar	600	0.575	0.233
Overall	3296	0.560	0.258

Table 23: *Semantic categories*: MRR Results of **FastText** with 5 epochs

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 61.12	p-value: 5.70×10^{-9}
	Spearman Result: 62.55	p-value: 1.97×10^{-9}
	OOV Ratio: 46.42	
Semantic Similarity	Pearson Result: 67.45	p-value: 4.83×10^{-50}
	Spearman Result: 70.37	p-value: 3.82×10^{-56}
	OOV Ratio: 26.6	

Table 24: Similarity test results for **FastText** with 5 epochs ($p \times 100$)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.111	0.600	0.339	77.16%
2. tekil kişi çekimi.txt	946	0.096	0.671	0.365	83.91%
2. çoğul kişi çekimi.txt	946	0.104	0.713	0.327	118.16%
3. çoğul kişi çekimi.txt	1128	0.286	0.581	0.42	38.42%
emir kipi.txt	1176	0.222	0.588	0.465	26.62%
gelecek zaman kipi.txt	1176	0.036	0.871	0.707	23.26%
gereklilik kipi.txt	1128	0.189	0.647	0.467	38.58%
geçmiş zaman eki (-di).txt	1176	0.255	0.599	0.535	11.96%
geçmiş zaman eki (-miş).txt	1176	0.084	0.782	0.774	1.09%
istek kipi.txt	1176	0.182	0.534	0.534	0.11%
olumsuzluk eki.txt	1176	0.097	0.773	0.67	15.40%
şimdiki zaman eki (-mekte).txt	1176	0.063	0.850	0.64	31.65%
şimdiki zaman eki (-yor).txt	861	0.066	0.880	0.847	3.94%
Overall	14231	0.141	0.697	0.549	26.95%

Table 25: *Fiil çekim ekleri*: MRR Result Comparison for **FastText** with 10 epochs

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.443	0.332	0.238	39.78%
-e eki.txt	1176	0.520	0.282	0.236	19.53%
1. tekil kişi iyelik.txt	1128	0.469	0.321	0.148	117.29%
1. çoğul kişi iyelik.txt	1128	0.300	0.487	0.25	94.96%
2. tekil kişi iyelik.txt	1176	0.466	0.371	0.321	15.85%
2. çoğul kişi iyelik.txt	1081	0.248	0.561	0.196	186.27%
3. tekil kişi iyelik eki.txt	1176	0.393	0.372	0.448	-16.80%
3. çoğul kişi iyelik.txt	1128	0.469	0.259	0.178	45.95%
eşitlik eki (-ce).txt	276	0.884	0.054	0.027	103.33%
ismin -de hali.txt	1128	0.607	0.204	0.136	50.0%
ismin -i hali.txt	1176	0.406	0.382	0.439	-12.82%
tamlayan eki.txt	1176	0.256	0.549	0.488	12.62%
vasıta eki (-le).txt	1128	0.356	0.418	0.253	65.57%
Overall	14005	0.421	0.371	0.274	35.40%

Table 26: *İsim çekim ekleri*: MRR Result Comparison for **FastText** with 10 epochs

Semantic Categories	Number of examples	Top-N Miss Ratio	MRR
Aile	90	0.333	0.412
Para birimi	156	0.827	0.079
Şehir-bölge	1344	0.553	0.232
Ülke-başkent	506	0.138	0.583
Eş anlamlılar	600	0.573	0.276
Zıt anlamlılar	600	0.52	0.296
Overall	3296	0.493	0.303

Table 27: *Semantic categories*: MRR Results of **FastText** with 10 epochs

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 66.51	p-value: 7.58 x 10^{-11}
	Spearman Result: 68.16	p-value: 1.67 x 10^{-11}
	OOV Ratio: 46.42	
Semantic Similarity	Pearson Result: 67.35	p-value: 7.74 x 10^{-50}
	Spearman Result: 70.53	p-value: 1.71 x 10^{-56}
	OOV Ratio: 26.6	

Table 28: Similarity test results for **FastText** with 10 epochs ($p \times 100$)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.031	0.829	0.339	144.54%
2. tekil kişi çekimi.txt	946	0.045	0.787	0.365	115.62%
2. çoğul kişi çekimi.txt	946	0.056	0.793	0.327	142.51%
3. çoğul kişi çekimi.txt	1128	0.309	0.587	0.42	39.76%
emir kipi.txt	1176	0.165	0.701	0.465	50.75%
gelecek zaman kipi.txt	1176	0.017	0.921	0.707	30.27%
gereklilik kipi.txt	1128	0.117	0.754	0.467	61.46%
geçmiş zaman eki (-di).txt	1176	0.077	0.778	0.535	45.42%
geçmiş zaman eki (-miş).txt	1176	0.076	0.856	0.774	10.59%
istek kipi.txt	1176	0.104	0.712	0.534	33.33%
olumsuzluk eki.txt	1176	0.032	0.885	0.67	32.09%
şimdiki zaman eki (-mekte).txt	1176	0.052	0.9	0.646	39.32%
şimdiki zaman eki (-yor).txt	861	0.039	0.928	0.847	9.56%
Overall	14231	0.088	0.801	0.549	45.81%

Table 29: *Fiil çekim ekleri*: MRR Results of **FastText** word embeddings prepared by Facebook AI

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.302	0.476	0.238	100.0%
-e eki.txt	1176	0.336	0.464	0.236	96.61%
1. tekil kişi iyelik.txt	1128	0.35	0.462	0.148	212.16%
1. çoğul kişi iyelik.txt	1128	0.254	0.547	0.25	118.8%
2. tekil kişi iyelik.txt	1176	0.392	0.464	0.321	44.55%
2. çoğul kişi iyelik.txt	1081	0.188	0.65	0.196	231.63%
3. tekil kişi iyelik eki.txt	1176	0.25	0.562	0.448	25.45%
3. çoğul kişi iyelik.txt	1128	0.24	0.553	0.178	210.67%
eşitlik eki (-ce).txt	276	0.873	0.061	0.027	125.93%
ismin -de hali.txt	1128	0.374	0.333	0.136	144.85%
ismin -i hali.txt	1176	0.283	0.512	0.439	16.63%
tamlayan eki.txt	1176	0.15	0.726	0.488	48.77%
vasıta eki (-le).txt	1128	0.277	0.534	0.253	111.07%
Overall	14005	0.295	0.514	0.275	87.21%

Table 30: *İsim çekim ekleri*: MRR Results of **FastText** word embeddings prepared by Facebook AI

Morphological Categories	Number of examples	Topn Miss Ratio	MRR
aile.txt	90	0.211	0.564
es-anlamlilar.txt	600	0.392	0.398
para-birimi.txt	156	0.801	0.094
sehir-bolge.txt	1344	0.365	0.339
zit-anlamlilar.txt	600	0.428	0.4
ülke-başkent.txt	506	0.316	0.277
Overall	3296	0.39	0.346

Table 31: *Semantic categories*: MRR Results of **FastText** word embeddings prepared by Facebook AI

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 76.92	p-value: 4.64×10^{-15}
	Spearman Result: 80.28	p-value: 3.76×10^{-17}
	OOV Ratio: 49.28	
Semantic Similarity	Pearson Result: 65.12	p-value: 1.72×10^{-43}
	Spearman Result: 68.92	p-value: 1.72×10^{-50}
	OOV Ratio: 30.2	

Table 32: Similarity test results for **FastText** word embeddings prepared by Facebook AI

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.193	0.486	0.339	43.36%
2. tekil kişi çekimi.txt	946	0.184	0.525	0.365	43.84%
2. çoğul kişi çekimi.txt	946	0.172	0.555	0.327	69.72%
3. çoğul kişi çekimi.txt	1128	0.294	0.51	0.42	21.43%
emir kipi.txt	1176	0.194	0.631	0.465	35.7%
gelecek zaman kipi.txt	1176	0.078	0.832	0.707	17.68%
gereklilik kipi.txt	1128	0.209	0.63	0.467	34.9%
geçmiş zaman eki (-di).txt	1176	0.231	0.618	0.535	15.51%
geçmiş zaman eki (-miş).txt	1176	0.104	0.791	0.774	2.2%
istek kipi.txt	1176	0.204	0.577	0.534	8.05%
olumsuzluk eki.txt	1176	0.111	0.679	0.67	1.34%
şimdiki zaman eki (-mekte).txt	1176	0.08	0.807	0.646	24.92%
şimdiki zaman eki (-yor).txt	861	0.042	0.892	0.847	5.31%
Overall	14231	0.162	0.658	0.549	19.8%

Table 33: *Fiil çekim ekleri*: MRR Results of word vectors generated by averaging **Word2Vec** and **FastText** word vectors (10 epochs)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.45	0.33	0.238	38.66%
-e eki.txt	1176	0.487	0.299	0.236	26.69%
1. tekil kişi iyelik.txt	1128	0.534	0.287	0.148	93.92%
1. çoğul kişi iyelik.txt	1128	0.404	0.427	0.25	70.8%
2. tekil kişi iyelik.txt	1176	0.499	0.341	0.321	6.23%
2. çoğul kişi iyelik.txt	1081	0.396	0.425	0.196	116.84%
3. tekil kişi iyelik eki.txt	1176	0.335	0.448	0.448	0.0%
3. çoğul kişi iyelik.txt	1128	0.475	0.247	0.178	38.76%
eşitlik eki (-ce).txt	276	0.942	0.037	0.027	37.04%
ismin -de hali.txt	1128	0.637	0.177	0.136	30.15%
ismin -i hali.txt	1176	0.336	0.451	0.439	2.73%
tamlayan eki.txt	1176	0.246	0.548	0.488	12.3%
vasıta eki (-le).txt	1128	0.405	0.386	0.253	52.57%
çoğul eki.txt	1128	0.322	0.496	1.0	-50.4%
Overall	15133	0.434	0.368	0.329	12.02%

Table 34: *İsim çekim ekleri*: MRR Results of word vectors generated by averaging **Word2Vec** and **FastText** word vectors (10 epochs)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR
aile.txt	90	0.222	0.597
es-anlamlilar.txt	600	0.44	0.395
para-birimi.txt	156	0.731	0.144
sehir-bolge.txt	1344	0.196	0.508
zit-anlamlilar.txt	600	0.402	0.396
ülke-başkent.txt	506	0.113	0.625
Overall	3296	0.291	0.470

Table 35: *Semantic categories*: MRR Results of word vectors generated by averaging **Word2Vec** and **FastText** word vectors (10 epochs)

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 79.12	p-value: 1.98×10^{-51}
	Spearman Result: 79.19	p-value: 7.97×10^{-60}
	OOV Ratio: 46.43	
Semantic Similarity	Pearson Result: 68.15	p-value: 2.97×10^{-17}
	Spearman Result: 71.98	p-value: 2.67×10^{-17}
	OOV Ratio: 26.60	

Table 36: Similarity test results for word vectors generated by averaging **Word2Vec** and **FastText** word vectors (10 epochs)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.851	0.061	0.339	-82.01%
2. tekil kişi çekimi.txt	946	0.93	0.033	0.365	-90.96%
2. çoğul kişi çekimi.txt	946	0.925	0.028	0.327	-91.44%
3. çoğul kişi çekimi.txt	1128	0.717	0.117	0.42	-72.14%
emir kipi.txt	1176	0.563	0.266	0.465	-42.8%
gelecek zaman kipi.txt	1176	0.237	0.606	0.707	-14.29%
gereklilik kipi.txt	1128	0.673	0.158	0.467	-66.17%
geçmiş zaman eki (-di).txt	1176	0.273	0.48	0.535	-10.28%
geçmiş zaman eki (-miş).txt	1176	0.204	0.596	0.774	-23.0%
istek kipi.txt	1176	0.622	0.214	0.534	-59.93%
olumsuzluk eki.txt	1176	0.27	0.509	0.67	-24.03%
şimdiki zaman eki (-mekte).txt	1176	0.407	0.408	0.646	-36.84%
şimdiki zaman eki (-yor).txt	861	0.108	0.753	0.847	-11.1%
Overall	14231	0.512	0.33	0.549	-39.88%

Table 37: *Fiil çekim ekleri*: MRR Results of **GloVe** word vectors (100 iterations, window size 5)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.832	0.092	0.238	-61.34%
-e eki.txt	1176	0.746	0.117	0.236	-50.42%
1. tekil kişi iyelik.txt	1128	0.965	0.013	0.148	-91.22%
1. çoğul kişi iyelik.txt	1128	0.907	0.038	0.25	-84.8%
2. tekil kişi iyelik.txt	1176	0.721	0.166	0.321	-48.29%
2. çoğul kişi iyelik.txt	1081	0.99	0.003	0.196	-98.47%
3. tekil kişi iyelik eki.txt	1176	0.409	0.319	0.448	-28.79%
3. çoğul kişi iyelik.txt	1128	0.732	0.097	0.178	-45.51%
eşitlik eki (-ce).txt	276	0.989	0.006	0.027	-77.78%
ismin -de hali.txt	1128	0.856	0.057	0.136	-58.09%
ismin -i hali.txt	1176	0.434	0.317	0.439	-27.79%
tamlayan eki.txt	1176	0.466	0.333	0.488	-31.76%
vasıta eki (-le).txt	1128	0.881	0.062	0.253	-75.49%
çoğul eki.txt	1128	0.538	0.266	1.0	-73.4%
Overall	15133	0.73	0.144	0.329	-56.15%

Table 38: *İsim çekim ekleri*: MRR Results of **GloVe** word vectors (100 iterations, window size 5)

Semantic Categories	Number of examples	Top-N Miss Ratio	MRR
aile.txt	90	0.356	0.423
es-anlamlilar.txt	600	0.522	0.271
para-birimi.txt	156	0.923	0.037
sehir-bolge.txt	1344	0.141	0.53
zit-anlamlilar.txt	600	0.368	0.385
ülke-başkent.txt	506	0.081	0.722
Overall	3296	0.285	0.46

Table 39: *Semantic categories*: MRR Results of **GloVe** word vectors (100 iterations, window size 5)

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 73.45	p-value: 0.00 x 10
	Spearman Result: 74.13	p-value: 0.00 x 10
	OOV Ratio: 39.29	
Semantic Similarity	Pearson Result: 61.59	p-value: 0.00 x 10
	Spearman Result: 64.33	p-value: 0.00 x 10
	OOV Ratio: 23.60	

Table 40: Similarity test results for **GloVe** word vectors (100 iterations, window size 5)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.787	0.092	0.339	-72.86%
2. tekil kişi çekimi.txt	946	0.875	0.051	0.365	-86.03%
2. çoğul kişi çekimi.txt	946	0.86	0.058	0.327	-82.26%
3. çoğul kişi çekimi.txt	1128	0.658	0.157	0.42	-62.62%
emir kipi.txt	1176	0.529	0.309	0.465	-33.55%
gelecek zaman kipi.txt	1176	0.213	0.634	0.707	-10.33%
gereklilik kipi.txt	1128	0.598	0.222	0.467	-52.46%
geçmiş zaman eki (-di).txt	1176	0.297	0.467	0.535	-12.71%
geçmiş zaman eki (-miş).txt	1176	0.19	0.611	0.774	-21.06%
istek kipi.txt	1176	0.591	0.251	0.534	-53.0%
olumsuzluk eki.txt	1176	0.209	0.566	0.67	-15.52%
şimdiki zaman eki (-mekte).txt	1176	0.349	0.489	0.646	-24.3%
şimdiki zaman eki (-yor).txt	861	0.093	0.73	0.847	-13.81%
Overall	14231	0.472	0.363	0.549	-33.92%

Table 41: *Fiil çekim ekleri*: MRR Results of **GloVe** word vectors (100 iterations, window size 10)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.782	0.112	0.238	-52.94%
-e eki.txt	1176	0.71	0.123	0.236	-47.88%
1. tekil kişi iyelik.txt	1128	0.95	0.022	0.148	-85.14%
1. çoğul kişi iyelik.txt	1128	0.862	0.069	0.25	-72.4%
2. tekil kişi iyelik.txt	1176	0.697	0.185	0.321	-42.37%
2. çoğul kişi iyelik.txt	1081	0.975	0.01	0.196	-94.9%
3. tekil kişi iyelik eki.txt	1176	0.367	0.388	0.448	-13.39%
3. çoğul kişi iyelik.txt	1128	0.713	0.12	0.178	-32.58%
eşitlik eki (-ce).txt	276	0.989	0.008	0.027	-70.37%
ismin -de hali.txt	1128	0.833	0.065	0.136	-52.21%
ismin -i hali.txt	1176	0.386	0.384	0.439	-12.53%
tamlayan eki.txt	1176	0.425	0.361	0.488	-26.02%
vasıta eki (-le).txt	1128	0.828	0.088	0.253	-65.22%
çoğul eki.txt	1128	0.506	0.301	1.0	-69.9%
Overall	15133	0.697	0.171	0.329	-48.07%

Table 42: *İsim çekim ekleri*: MRR Results of **GloVe** word vectors (100 iterations, window size 10)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR
aile.txt	90	0.344	0.49
es-anlamlilar.txt	600	0.528	0.278
para-birimi.txt	156	0.878	0.071
sehir-bolge.txt	1344	0.092	0.614
zit-anlamlilar.txt	600	0.367	0.404
ülke-başkent.txt	506	0.061	0.712
Overall	3296	0.261	0.501

Table 43: *Semantic categories*: MRR Results of **GloVe** word vectors (100 iterations, window size 10)

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 69.87	p-value: 0.00 x 10
	Spearman Result: 72.33	p-value: 0.00 x 10
	OOV Ratio: 47.14	
Semantic Similarity	Pearson Result: 67.93	p-value: 0.00 x 10
	Spearman Result: 70.89	p-value: 0.00 x 10
	OOV Ratio: 26.60	

Table 44: Similarity test results for **GloVe** word vectors (100 iterations, window size 10)

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.666	0.103	0.339	-69.62%
2. tekil kişi çekimi.txt	946	0.573	0.125	0.365	-65.75%
2. çoğul kişi çekimi.txt	946	0.548	0.193	0.327	-40.98%
3. çoğul kişi çekimi.txt	1128	0.715	0.076	0.42	-81.9%
emir kipi.txt	1176	0.804	0.047	0.465	-89.89%
gelecek zaman kipi.txt	1176	0.405	0.329	0.707	-53.47%
gereklilik kipi.txt	1128	0.568	0.216	0.467	-53.75%
geçmiş zaman eki (-di).txt	1176	0.481	0.304	0.535	-43.18%
geçmiş zaman eki (-miş).txt	1176	0.444	0.374	0.774	-51.68%
istek kipi.txt	1176	0.542	0.198	0.534	-62.92%
olumsuzluk eki.txt	1176	0.545	0.211	0.67	-68.51%
şimdiki zaman eki (-mekte).txt	1176	0.279	0.51	0.646	-21.05%
şimdiki zaman eki (-yor).txt	861	0.365	0.373	0.847	-55.96%
Overall	14231	0.534	0.237	0.549	-56.82%

Table 45: *Fiil çekim ekleri*: MRR Results of static word vectors generated by **ELMo** trained on Turkish CoNLL17 corpus.

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.266	0.461	0.339	35.99%
2. tekil kişi çekimi.txt	946	0.374	0.418	0.365	14.52%
2. çoğul kişi çekimi.txt	946	0.376	0.407	0.327	24.46%
3. çoğul kişi çekimi.txt	1128	0.373	0.4	0.42	-4.76%
emir kipi.txt	1176	0.231	0.593	0.465	27.53%
gelecek zaman kipi.txt	1176	0.094	0.83	0.707	17.4%
gereklilik kipi.txt	1128	0.267	0.509	0.467	8.99%
geçmiş zaman eki (-di).txt	1176	0.223	0.637	0.535	19.07%
geçmiş zaman eki (-miş).txt	1176	0.122	0.763	0.774	-1.42%
istek kipi.txt	1176	0.23	0.62	0.534	16.1%
olumsuzluk eki.txt	1176	0.21	0.58	0.67	-13.43%
şimdiki zaman eki (-mekte).txt	1176	0.103	0.826	0.646	27.86%
şimdiki zaman eki (-yor).txt	861	0.067	0.869	0.847	2.6%
Overall	14231	0.223	0.612	0.549	11.51%

Table 46: *Fiil Çekim Ekleri*: MRR Results of **Word2Vec CBOW** with 10 epoch

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.479	0.349	0.238	46.64%
-e eki.txt	1176	0.412	0.417	0.236	76.69%
1. tekil kişi iyelik.txt	1128	0.585	0.254	0.148	71.62%
1. çoğul kişi iyelik.txt	1128	0.449	0.374	0.25	49.6%
2. tekil kişi iyelik.txt	1176	0.535	0.377	0.321	17.45%
2. çoğul kişi iyelik.txt	1081	0.492	0.317	0.196	61.73%
3. tekil kişi iyelik eki.txt	1176	0.38	0.418	0.448	-6.7%
3. çoğul kişi iyelik.txt	1128	0.432	0.316	0.178	77.53%
eşitlik eki (-ce).txt	276	0.946	0.036	0.027	33.33%
ismin -de hali.txt	1128	0.516	0.289	0.136	112.5%
ismin -i hali.txt	1176	0.381	0.42	0.439	-4.33%
tamlayan eki.txt	1176	0.241	0.629	0.488	28.89%
vasıta eki (-le).txt	1128	0.399	0.45	0.253	77.87%
çoğul eki.txt	1128	0.316	0.53	1.0	-47.0%
Overall	15133	0.441	0.39	0.329	18.59%

Table 47: *İsim Çekim Ekleri*: MRR Results of **Word2Vec CBOW** with 10 epoch

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
aile.txt	90	0.289	0.499	1.0	-50.1%
es-anlamlilar.txt	600	0.422	0.405	1.0	-59.5%
para-birimi.txt	156	0.724	0.158	1.0	-84.2%
sehir-bolge.txt	1344	0.222	0.425	1.0	-57.5%
zit-anlamlilar.txt	600	0.367	0.374	1.0	-62.6%
ülke-başkent.txt	506	0.249	0.504	1.0	-49.6%
Overall	3296	0.315	0.414	1.0	-58.64%

Table 48: *Semantic categories*: MRR Results of **Word2Vec CBOW** with 10 epoch

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 77.62	p-value: 0.00 x 10
	Spearman Result: 76.90	p-value: 0.00 x 10
	OOV Ratio: 46.43	
Semantic Similarity	Pearson Result: 66.16	p-value: 0.00 x 10
	Spearman Result: 68.77	p-value: 0.00 x 10
	OOV Ratio: 26.60	

Table 49: Similarity test results of static word vectors generated by **Word2Vec CBOW** with 10 epoch

Morphological Categories	Number of examples	Topn Miss Ratio	MRR
aile.txt	90	0.856	0.066
es-anlamlilar.txt	600	0.928	0.029
para-birimi.txt	156	0.571	0.001
sehir-bolge.txt	1344	0.755	0.077
zit-anlamlilar.txt	600	0.657	0.214
ülke-başkent.txt	506	0.259	0.001
Overall	3296	0.687	0.078

Table 51: *Semantic categories*: MRR Results of static word vectors generated by **ELMo** trained on Turkish CoNLL17 corpus.

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 39.11	p-value: 2.00 x 10^{-3}
	Spearman Result: 39.43	p-value: 1.00 x 10^{-3}
	OOV Ratio: 55.00	
Semantic Similarity	Pearson Result: 35.18	p-value: 0.00 x 10
	Spearman Result: 36.77	p-value: 0.00 x 10
	OOV Ratio: 28.20	

Table 52: Similarity test results of static word vectors generated by **ELMo** trained on Turkish CoNLL17 corpus.

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.97	0.018	0.339	-94.69%
2. tekil kişi çekimi.txt	946	0.932	0.033	0.365	-90.96%
2. çoğul kişi çekimi.txt	946	0.928	0.04	0.327	-87.77%
3. çoğul kişi çekimi.txt	1128	0.961	0.019	0.42	-95.48%
emir kipi.txt	1176	0.959	0.016	0.465	-96.56%
gelecek zaman kipi.txt	1176	0.872	0.068	0.707	-90.38%
gereklilik kipi.txt	1128	0.946	0.026	0.467	-94.43%
geçmiş zaman eki (-di).txt	1176	0.966	0.02	0.535	-96.26%
geçmiş zaman eki (-miş).txt	1176	0.88	0.087	0.774	-88.76%
istek kipi.txt	1176	0.963	0.022	0.534	-95.88%
olumsuzluk eki.txt	1176	0.91	0.041	0.67	-93.88%
şimdiki zaman eki (-mekte).txt	1176	0.962	0.018	0.646	-97.21%
şimdiki zaman eki (-yor).txt	861	0.855	0.091	0.847	-89.26%
Overall	14231	0.932	0.038	0.549	-93.14%

Table 53: *Fiil çekim ekleri*: MRR Results of static word vectors generated by **Bert**.

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.687	0.151	0.238	-36.55%
-e eki.txt	1176	0.635	0.23	0.236	-2.54%
1. tekil kişi iyelik.txt	1128	0.699	0.082	0.148	-44.59%
1. çoğul kişi iyelik.txt	1128	0.643	0.117	0.25	-53.2%
2. tekil kişi iyelik.txt	1176	0.665	0.14	0.321	-56.39%
2. çoğul kişi iyelik.txt	1081	0.461	0.077	0.196	-60.71%
3. tekil kişi iyelik eki.txt	1176	0.623	0.213	0.448	-52.46%
3. çoğul kişi iyelik.txt	1128	0.694	0.171	0.178	-3.93%
eşitlik eki (-ce).txt	276	0.511	0.009	0.027	-66.67%
ismin -de hali.txt	1128	0.666	0.116	0.136	-14.71%
ismin -i hali.txt	1176	0.677	0.178	0.439	-59.45%
tamlayan eki.txt	1176	0.498	0.3	0.488	-38.52%
vasıta eki (-le).txt	1128	0.612	0.191	0.253	-24.51%
çoğul eki.txt	1128	0.69	0.169	1.0	-83.1%
Overall	15133	0.633	0.162	0.329	-50.6%

Table 50: *İsim çekim ekleri*: MRR Results of static word vectors generated by **ELMo** trained on Turkish CoNLL17 corpus.

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.938	0.027	0.238	-88.66%
-e eki.txt	1176	0.95	0.019	0.236	-91.95%
1. tekil kişi iyelik.txt	1128	0.968	0.014	0.148	-90.54%
1. çoğul kişi iyelik.txt	1128	0.965	0.013	0.25	-94.8%
2. tekil kişi iyelik.txt	1176	0.954	0.027	0.321	-91.59%
2. çoğul kişi iyelik.txt	1081	0.986	0.009	0.196	-95.41%
3. tekil kişi iyelik eki.txt	1176	0.895	0.059	0.448	-86.83%
3. çoğul kişi iyelik.txt	1128	0.938	0.027	0.178	-84.83%
eşitlik eki (-ce).txt	276	0.946	0.009	0.027	-66.67%
ismin -de hali.txt	1128	0.931	0.028	0.136	-79.41%
ismin -i hali.txt	1176	0.883	0.078	0.439	-82.23%
tamlayan eki.txt	1176	0.937	0.038	0.488	-92.21%
vasıta eki (-le).txt	1128	0.98	0.009	0.253	-96.44%
çoğul eki.txt	1128	0.812	0.123	1.0	-87.7%
Overall	15133	0.934	0.036	0.329	-89.07%

Table 54: *İsim çekim ekleri*: MRR Results of static word vectors generated by **Bert**.

Semantic Categories	Number of examples	Top-N Miss Ratio	MRR
aile.txt	90	0.767	0.137
es-anlamlilar.txt	600	0.848	0.072
para-birimi.txt	156	0.987	0.003
sehir-bolge.txt	1344	0.947	0.032
zit-anlamlilar.txt	600	0.968	0.017
ülke-başkent.txt	506	0.978	0.007
Overall	3296	0.935	0.034

Table 55: *Semantic categories*: MRR Results of static word vectors generated by **Bert**.

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 25.17	p-value: 2.00×10^{-2}
	Spearman Result: 28.45	p-value: 8.00×10^{-3}
	OOV Ratio: 39.29	
Semantic Similarity	Pearson Result: 10.65	p-value: 3.70×10^{-2}
	Spearman Result: 12.63	p-value: 1.30×10^{-2}
	OOV Ratio: 23.60	

Table 56: Similarity test results of static word vectors generated by **Bert** trained on Turkish CoNLL17 corpus.

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.914	0.041	0.339	-87.91%
2. tekil kişi çekimi.txt	946	0.849	0.079	0.365	-78.36%
2. çoğul kişi çekimi.txt	946	0.885	0.058	0.327	-82.26%
3. çoğul kişi çekimi.txt	1128	0.919	0.051	0.42	-87.86%
emir kipi.txt	1176	0.872	0.064	0.465	-86.24%
gelecek zaman kipi.txt	1176	0.849	0.097	0.707	-86.28%
gereklilik kipi.txt	1128	0.874	0.073	0.467	-84.37%
geçmiş zaman eki (-di).txt	1176	0.92	0.036	0.535	-93.27%
geçmiş zaman eki (-miş).txt	1176	0.869	0.081	0.774	-89.53%
istek kipi.txt	1176	0.935	0.031	0.534	-94.19%
olumsuzluk eki.txt	1176	0.816	0.119	0.67	-82.24%
şimdiki zaman eki (-mekte).txt	1176	0.928	0.046	0.646	-92.88%
şimdiki zaman eki (-yor).txt	861	0.843	0.088	0.847	-89.61%
Overall	14231	0.883	0.066	0.549	-87.93%

Table 57: *Fiil çekim ekleri*: MRR Results of static word vectors generated by aggregating **Bert** embeddings.

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.934	0.025	0.238	-89.5%
-e eki.txt	1176	0.883	0.061	0.236	-74.15%
1. tekil kişi iyelik.txt	1128	0.98	0.009	0.148	-93.92%
1. çoğul kişi iyelik.txt	1128	0.931	0.04	0.25	-84.0%
2. tekil kişi iyelik.txt	1176	0.908	0.046	0.321	-85.67%
2. çoğul kişi iyelik.txt	1081	0.935	0.031	0.196	-84.18%
3. tekil kişi iyelik eki.txt	1176	0.781	0.117	0.448	-73.88%
3. çoğul kişi iyelik.txt	1128	0.939	0.026	0.178	-85.39%
eşitlik eki (-ce).txt	276	0.996	0.004	0.027	-85.19%
ismin -de hali.txt	1128	0.951	0.02	0.136	-85.29%
ismin -i hali.txt	1176	0.726	0.145	0.439	-66.97%
tamlayan eki.txt	1176	0.822	0.083	0.488	-82.99%
vasıta eki (-le).txt	1128	0.94	0.028	0.253	-88.93%
çoğul eki.txt	1128	0.848	0.081	1.0	-91.9%
Overall	15133	0.891	0.054	0.329	-83.43%

Table 58: *İsim çekim ekleri*: MRR Results of static word vectors generated by aggregating **Bert** embeddings.

Semantic Categories	Number of examples	Top-N Miss Ratio	MRR
aile.txt	90	0.889	0.067
es-anlamlilar.txt	600	0.995	0.001
para-birimi.txt	156	0.968	0.024
sehir-bolge.txt	1344	0.562	0.264
zit-anlamlilar.txt	600	0.873	0.067
ülke-başkent.txt	506	0.583	0.249
Overall	3296	0.729	0.161

Table 59: *Semantic categories*: MRR Results of static word vectors generated by aggregating **Bert** embeddings.

Similarity Task	Statistics	
Syntactic Similarity	Pearson Result: 24.76	p-value: 3.50×10^{-2}
	Spearman Result: 31.05	p-value: 8.00×10^{-3}
	OOV Ratio: 47.86	
Semantic Similarity	Pearson Result: 26.58	p-value: 0.00×10
	Spearman Result: 32.14	p-value: 0.00×10
	OOV Ratio: 28.60	

Table 60: Similarity test results of static word vectors generated by aggregating **Bert** embeddings trained on Turkish CoNLL17 corpus.

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
1. tekil kişi çekimi.txt	990	0.116	0.684	0.339	101.77%
2. tekil kişi çekimi.txt	946	0.093	0.733	0.365	100.82%
2. çoğul kişi çekimi.txt	946	0.075	0.713	0.327	118.04%
3. çoğul kişi çekimi.txt	1128	0.273	0.541	0.42	28.81%
emir kipi.txt	1176	0.069	0.779	0.465	67.53%
gelecek zaman kipi.txt	1176	0.025	0.882	0.707	24.75%
gereklilik kipi.txt	1128	0.121	0.71	0.467	52.03%
geçmiş zaman eki (-di).txt	1176	0.105	0.75	0.535	40.19%
geçmiş zaman eki (-miş).txt	1176	0.043	0.887	0.774	14.6%
istek kipi.txt	1176	0.079	0.819	0.534	53.37%
olumsuzluk eki.txt	1176	0.046	0.751	0.67	12.09%
şimdiki zaman eki (-mekte).txt	1176	0.044	0.843	0.646	30.5%
şimdiki zaman eki (-yor).txt	861	0.015	0.924	0.847	9.09%
Overall	14231	0.085	0.771	0.549	40.37%

Table 61: *Fiil çekim ekleri*: MRR Results of static word vectors generated with **X2Static** from BERT model.

Morphological Categories	Number of examples	Topn Miss Ratio	MRR	Reference MRR	Improvement with respect to reference
-den eki.txt	1128	0.171	0.491	0.238	106.3%
-e eki.txt	1176	0.194	0.502	0.236	112.71%
1. tekil kişi iyelik.txt	1128	0.362	0.39	0.148	163.51%
1. çoğul kişi iyelik.txt	1128	0.233	0.498	0.25	99.2%
2. tekil kişi iyelik.txt	1176	0.407	0.449	0.321	39.88%
2. çoğul kişi iyelik.txt	1081	0.241	0.527	0.196	168.88%
3. tekil kişi iyelik eki.txt	1176	0.099	0.59	0.448	31.7%
3. çoğul kişi iyelik.txt	1128	0.271	0.327	0.178	83.71%
eşitlik eki (-ce).txt	276	0.663	0.096	0.027	255.56%
ismin -de hali.txt	1128	0.376	0.291	0.136	113.97%
ismin -i hali.txt	1176	0.102	0.646	0.439	47.15%
tamlayan eki.txt	1176	0.093	0.721	0.488	47.75%
vasıta eki (-le).txt	1128	0.185	0.544	0.253	115.02%
çoğul eki.txt	1128	0.196	0.599	1.0	-40.1%
Overall	15133	0.233	0.499	0.329	51.88%

Table 62: *İsim çekim ekleri*: MRR Results of static word vectors generated with **X2Static** from BERT model.

Semantic Categories	Number of examples	Top-N Miss Ratio	MRR
aile.txt	90	0.244	0.546
es-anlamlilar.txt	600	0.402	0.39
para-birimi.txt	156	0.673	0.141
sehir-bolge.txt	1344	0.249	0.439
zit-anlamlilar.txt	600	0.372	0.437
ülke-başkent.txt	506	0.342	0.258
Overall	3296	0.333	0.391

Table 63: *Semantic Categories*: MRR Results of static word vectors generated with **X2Static** from BERT model.

References