

Appendix

A Full Experiments

We provide detailed tables for all experiments in the Tables below, including Table 4, 5, 6, 7, 8, 9, 10, 11. These results complement the main paper by offering a more comprehensive breakdown of performance across different tasks and evaluation settings.

Table 4: Performance of Models: Baseline.

Model	Dataset	NDCG@5	NDCG@10	Recall@5	Recall@10	Precision@5	Precision@10
BM3	Baby	0.0211	0.0275	0.0323	0.0517	0.0071	0.0057
	Clothing	0.0168	0.0208	0.0252	0.0375	0.0052	0.0039
	Sports	0.0251	0.0326	0.0374	0.0603	0.0081	0.0066
DAMRS	Baby	0.0253	0.0326	0.0381	0.0604	0.0083	0.0066
	Clothing	0.0232	0.0296	0.0355	0.0552	0.0073	0.0057
	Sports	0.0283	0.0362	0.0431	0.0673	0.0094	0.0074
DRAGON	Baby	0.0270	0.0342	0.0404	0.0625	0.0088	0.0068
	Clothing	0.0266	0.0340	0.0405	0.0636	0.0084	0.0066
	Sports	0.0310	0.0400	0.0469	0.0744	0.0103	0.0082
DualGNN	Baby	0.0211	0.0268	0.0316	0.0490	0.0070	0.0054
	Clothing	0.0172	0.0223	0.0265	0.0420	0.0055	0.0044
	Sports	0.0261	0.0329	0.0386	0.0595	0.0085	0.0066
FREEDOM	Baby	0.0252	0.0329	0.0383	0.0617	0.0083	0.0067
	Clothing	0.0249	0.0320	0.0381	0.0598	0.0079	0.0062
	Sports	0.0318	0.0403	0.0476	0.0735	0.0104	0.0081
GRCN	Baby	0.0229	0.0292	0.0343	0.0533	0.0075	0.0059
	Clothing	0.0172	0.0221	0.0266	0.0417	0.0055	0.0043
	Sports	0.0245	0.0309	0.0361	0.0557	0.0080	0.0062
LATTICE	Baby	0.0231	0.0295	0.0341	0.0537	0.0075	0.0059
	Clothing	0.0200	0.0251	0.0306	0.0463	0.0063	0.0048
	Sports	0.0273	0.0341	0.0414	0.0622	0.0090	0.0069
LGMRec	Baby	0.0265	0.0331	0.0395	0.0595	0.0086	0.0065
	Clothing	0.0234	0.0293	0.0352	0.0535	0.0073	0.0055
	Sports	0.0306	0.0386	0.0468	0.0710	0.0102	0.0078
MGCN	Baby	0.0259	0.0329	0.0381	0.0595	0.0083	0.0065
	Clothing	0.0273	0.0350	0.0415	0.0651	0.0086	0.0067
	Sports	0.0324	0.0412	0.0485	0.0755	0.0106	0.0083
MMGCN	Baby	0.0148	0.0196	0.0217	0.0365	0.0048	0.0041
	Clothing	0.0075	0.0102	0.0119	0.0202	0.0025	0.0021
	Sports	0.0159	0.0201	0.0240	0.0370	0.0054	0.0042
PGL	Baby	0.0235	0.0307	0.0361	0.0579	0.0079	0.0064
	Clothing	0.0207	0.0272	0.0318	0.0517	0.0066	0.0054
	Sports	0.0297	0.0381	0.0441	0.0697	0.0096	0.0076
SLMRec	Baby	0.0223	0.0275	0.0335	0.0492	0.0073	0.0054
	Clothing	0.0174	0.0225	0.0265	0.0422	0.0055	0.0044
	Sports	0.0288	0.0365	0.0427	0.0663	0.0094	0.0073
SMORE	Baby	0.0286	0.0359	0.0422	0.0647	0.0092	0.0071
	Clothing	0.0276	0.0352	0.0421	0.0654	0.0087	0.0068
	Sports	0.0327	0.0414	0.0488	0.0756	0.0107	0.0083
VBPR	Baby	0.0160	0.0211	0.0245	0.0402	0.0054	0.0045
	Clothing	0.0119	0.0150	0.0181	0.0278	0.0038	0.0029
	Sports	0.0230	0.0295	0.0349	0.0547	0.0077	0.0061

Table 5: Performance Comparison for Method: Dual Knockout with Noise.

Model	Dataset	NDCG@5	NDCG@10	Recall@5	Recall@10	Precision@5	Precision@10
BM3	Baby	0.0216 (+2.4%)	0.0283 (+2.9%)	0.0328 (+1.5%)	0.0533 (+3.1%)	0.0072 (+1.4%)	0.0059 (+3.5%)
	Clothing	0.0155 (-7.7%)	0.0198 (-4.8%)	0.0238 (-5.6%)	0.0371 (-1.1%)	0.0049 (-5.8%)	0.0039 (+0.0%)
	Sports	0.0254 (+1.2%)	0.0318 (-2.5%)	0.0379 (+1.3%)	0.0575 (-4.6%)	0.0083 (+2.5%)	0.0063 (-4.5%)
DAMRS	Baby	0.0198 (-21.7%)	0.0252 (-22.7%)	0.0307 (-19.4%)	0.0470 (-22.2%)	0.0067 (-19.3%)	0.0052 (-21.2%)
	Clothing	0.0141 (-39.2%)	0.0178 (-39.9%)	0.0212 (-40.3%)	0.0326 (-40.9%)	0.0044 (-39.7%)	0.0034 (-40.4%)
	Sports	0.0231 (-18.4%)	0.0294 (-18.8%)	0.0342 (-20.6%)	0.0532 (-21.0%)	0.0075 (-20.2%)	0.0059 (-20.3%)
DRAGON	Baby	0.0149 (-44.8%)	0.0195 (-43.0%)	0.0224 (-44.6%)	0.0362 (-42.1%)	0.0050 (-43.2%)	0.0041 (-39.7%)
	Clothing	0.0117 (-56.0%)	0.0151 (-55.6%)	0.0180 (-55.6%)	0.0286 (-55.0%)	0.0038 (-54.8%)	0.0030 (-54.5%)
	Sports	0.0227 (-26.8%)	0.0281 (-29.8%)	0.0339 (-27.7%)	0.0504 (-32.3%)	0.0074 (-28.2%)	0.0056 (-31.7%)
DualGNN	Baby	0.0156 (-26.1%)	0.0202 (-24.6%)	0.0240 (-24.1%)	0.0379 (-22.7%)	0.0053 (-24.3%)	0.0042 (-22.2%)
	Clothing	0.0085 (-50.6%)	0.0111 (-50.2%)	0.0132 (-50.2%)	0.0213 (-49.3%)	0.0028 (-49.1%)	0.0022 (-50.0%)
	Sports	0.0200 (-23.4%)	0.0254 (-22.8%)	0.0299 (-22.5%)	0.0464 (-22.0%)	0.0066 (-22.4%)	0.0052 (-21.2%)
FREEDOM	Baby	0.0178 (-29.4%)	0.0232 (-29.5%)	0.0270 (-29.5%)	0.0436 (-29.3%)	0.0059 (-28.9%)	0.0048 (-28.4%)
	Clothing	0.0106 (-57.4%)	0.0136 (-57.5%)	0.0165 (-56.7%)	0.0258 (-56.9%)	0.0034 (-57.0%)	0.0027 (-56.5%)
	Sports	0.0216 (-32.1%)	0.0274 (-32.0%)	0.0325 (-31.7%)	0.0500 (-32.0%)	0.0071 (-31.7%)	0.0056 (-30.9%)
GRCN	Baby	0.0181 (-21.0%)	0.0238 (-18.5%)	0.0274 (-20.1%)	0.0445 (-16.5%)	0.0061 (-18.7%)	0.0050 (-15.3%)
	Clothing	0.0110 (-36.0%)	0.0145 (-34.4%)	0.0173 (-35.0%)	0.0280 (-32.9%)	0.0036 (-34.5%)	0.0029 (-32.6%)
	Sports	0.0208 (-15.1%)	0.0267 (-13.6%)	0.0307 (-15.0%)	0.0485 (-12.9%)	0.0068 (-15.0%)	0.0054 (-12.9%)
LATTICE	Baby	0.0173 (-25.1%)	0.0226 (-23.4%)	0.0259 (-24.0%)	0.0424 (-21.0%)	0.0058 (-22.7%)	0.0047 (-20.3%)
	Clothing	0.0122 (-39.0%)	0.0156 (-37.8%)	0.0186 (-39.2%)	0.0291 (-37.1%)	0.0039 (-38.1%)	0.0030 (-37.5%)
	Sports	0.0225 (-17.6%)	0.0282 (-17.3%)	0.0331 (-20.0%)	0.0508 (-18.3%)	0.0073 (-18.9%)	0.0056 (-18.8%)
LGMRec	Baby	0.0175 (-34.0%)	0.0226 (-31.7%)	0.0263 (-33.4%)	0.0420 (-29.4%)	0.0058 (-32.6%)	0.0047 (-27.7%)
	Clothing	0.0077 (-67.1%)	0.0103 (-64.8%)	0.0117 (-66.8%)	0.0198 (-63.0%)	0.0025 (-65.8%)	0.0021 (-61.8%)
	Sports	0.0194 (-36.6%)	0.0249 (-35.5%)	0.0293 (-37.4%)	0.0463 (-34.8%)	0.0065 (-36.3%)	0.0051 (-34.6%)
MGCN	Baby	0.0199 (-23.2%)	0.0256 (-22.2%)	0.0297 (-22.0%)	0.0474 (-20.3%)	0.0066 (-20.5%)	0.0053 (-18.5%)
	Clothing	0.0125 (-54.2%)	0.0157 (-55.1%)	0.0189 (-54.5%)	0.0289 (-55.6%)	0.0039 (-54.7%)	0.0030 (-55.2%)
	Sports	0.0235 (-27.5%)	0.0297 (-27.9%)	0.0349 (-28.0%)	0.0539 (-28.6%)	0.0077 (-27.4%)	0.0059 (-28.9%)
MMGCN	Baby	0.0127 (-14.2%)	0.0163 (-16.8%)	0.0192 (-11.5%)	0.0300 (-17.8%)	0.0042 (-12.5%)	0.0033 (-19.5%)
	Clothing	0.0037 (-50.7%)	0.0053 (-48.0%)	0.0059 (-50.4%)	0.0109 (-46.0%)	0.0012 (-52.0%)	0.0011 (-47.6%)
	Sports	0.0106 (-33.3%)	0.0140 (-30.3%)	0.0161 (-32.9%)	0.0264 (-28.6%)	0.0036 (-33.3%)	0.0030 (-28.6%)
PGL	Baby	0.0188 (-20.0%)	0.0245 (-20.2%)	0.0281 (-22.2%)	0.0456 (-21.2%)	0.0062 (-21.5%)	0.0051 (-20.3%)
	Clothing	0.0126 (-39.1%)	0.0159 (-41.5%)	0.0191 (-39.9%)	0.0293 (-43.3%)	0.0040 (-39.4%)	0.0031 (-42.6%)
	Sports	0.0238 (-19.9%)	0.0303 (-20.5%)	0.0355 (-19.5%)	0.0555 (-20.4%)	0.0078 (-18.7%)	0.0061 (-19.7%)
SLMRec	Baby	0.0216 (-3.1%)	0.0271 (-1.5%)	0.0319 (-4.8%)	0.0485 (-1.4%)	0.0071 (-2.7%)	0.0054 (+0.0%)
	Clothing	0.0174 (+0.0%)	0.0222 (-1.3%)	0.0263 (-0.8%)	0.0409 (-3.1%)	0.0055 (+0.0%)	0.0043 (-2.3%)
	Sports	0.0287 (-0.3%)	0.0359 (-1.6%)	0.0425 (-0.5%)	0.0642 (-3.2%)	0.0094 (+0.0%)	0.0071 (-2.7%)
SMORE	Baby	0.0200 (-30.1%)	0.0257 (-28.4%)	0.0302 (-28.4%)	0.0475 (-26.6%)	0.0067 (-27.2%)	0.0053 (-25.4%)
	Clothing	0.0128 (-53.6%)	0.0161 (-54.3%)	0.0197 (-53.2%)	0.0298 (-54.4%)	0.0041 (-52.9%)	0.0031 (-54.4%)
	Sports	0.0241 (-26.3%)	0.0305 (-26.3%)	0.0359 (-26.4%)	0.0553 (-26.9%)	0.0079 (-26.2%)	0.0061 (-26.5%)
VBPR	Baby	0.0171 (+6.9%)	0.0224 (+6.2%)	0.0254 (+3.7%)	0.0417 (+3.7%)	0.0057 (+5.6%)	0.0047 (+4.4%)
	Clothing	0.0111 (-6.7%)	0.0142 (-5.3%)	0.0165 (-8.8%)	0.0261 (-6.1%)	0.0035 (-7.9%)	0.0028 (-3.4%)
	Sports	0.0233 (+1.3%)	0.0295 (+0.0%)	0.0352 (+0.9%)	0.0543 (-0.7%)	0.0077 (+0.0%)	0.0060 (-1.6%)

Table 6: Performance Comparison for Method: Text Knockout with Noise.

Model	Dataset	NDCG@5	NDCG@10	Recall@5	Recall@10	Precision@5	Precision@10
BM3	Baby	0.0209 (-0.9%)	0.0270 (-1.8%)	0.0319 (-1.2%)	0.0506 (-2.1%)	0.0071 (+0.0%)	0.0056 (-1.8%)
	Clothing	0.0154 (-8.3%)	0.0196 (-5.8%)	0.0237 (-6.0%)	0.0368 (-1.9%)	0.0049 (-5.8%)	0.0038 (-2.6%)
	Sports	0.0239 (-4.8%)	0.0307 (-5.8%)	0.0358 (-4.3%)	0.0566 (-6.1%)	0.0078 (-3.7%)	0.0062 (-6.1%)
DAMRS	Baby	0.0202 (-20.2%)	0.0263 (-19.3%)	0.0310 (-18.6%)	0.0496 (-17.9%)	0.0068 (-18.1%)	0.0055 (-16.7%)
	Clothing	0.0168 (-27.6%)	0.0216 (-27.0%)	0.0256 (-27.9%)	0.0405 (-26.6%)	0.0053 (-27.4%)	0.0042 (-26.3%)
	Sports	0.0247 (-12.7%)	0.0319 (-11.9%)	0.0371 (-13.9%)	0.0589 (-12.5%)	0.0081 (-13.8%)	0.0065 (-12.2%)
DRAGON	Baby	0.0205 (-24.1%)	0.0266 (-22.2%)	0.0309 (-23.5%)	0.0494 (-21.0%)	0.0068 (-22.7%)	0.0055 (-19.1%)
	Clothing	0.0156 (-41.4%)	0.0201 (-40.9%)	0.0239 (-41.0%)	0.0378 (-40.6%)	0.0050 (-40.5%)	0.0039 (-40.9%)
	Sports	0.0255 (-17.7%)	0.0321 (-19.8%)	0.0385 (-17.9%)	0.0585 (-21.4%)	0.0084 (-18.4%)	0.0065 (-20.7%)
DualGNN	Baby	0.0176 (-16.6%)	0.0229 (-14.6%)	0.0263 (-16.8%)	0.0424 (-13.5%)	0.0059 (-15.7%)	0.0047 (-13.0%)
	Clothing	0.0111 (-35.5%)	0.0148 (-33.6%)	0.0172 (-35.1%)	0.0288 (-31.4%)	0.0036 (-34.5%)	0.0030 (-31.8%)
	Sports	0.0213 (-18.4%)	0.0270 (-17.9%)	0.0321 (-16.8%)	0.0494 (-17.0%)	0.0071 (-16.5%)	0.0055 (-16.7%)
FREEDOM	Baby	0.0180 (-28.6%)	0.0237 (-28.0%)	0.0273 (-28.7%)	0.0446 (-27.7%)	0.0060 (-27.7%)	0.0049 (-26.9%)
	Clothing	0.0115 (-53.8%)	0.0148 (-53.8%)	0.0180 (-52.8%)	0.0282 (-52.8%)	0.0038 (-51.9%)	0.0029 (-53.2%)
	Sports	0.0222 (-30.2%)	0.0282 (-30.0%)	0.0337 (-29.2%)	0.0520 (-29.3%)	0.0074 (-28.8%)	0.0058 (-28.4%)
GRCN	Baby	0.0207 (-9.6%)	0.0262 (-10.3%)	0.0307 (-10.5%)	0.0474 (-11.1%)	0.0069 (-8.0%)	0.0053 (-10.2%)
	Clothing	0.0136 (-20.9%)	0.0177 (-19.9%)	0.0208 (-21.8%)	0.0332 (-20.4%)	0.0044 (-20.0%)	0.0035 (-18.6%)
	Sports	0.0229 (-6.5%)	0.0290 (-6.1%)	0.0338 (-6.4%)	0.0522 (-6.3%)	0.0075 (-6.3%)	0.0058 (-6.5%)
LATTICE	Baby	0.0188 (-18.6%)	0.0243 (-17.6%)	0.0289 (-15.2%)	0.0456 (-15.1%)	0.0064 (-14.7%)	0.0051 (-13.6%)
	Clothing	0.0142 (-29.0%)	0.0183 (-27.1%)	0.0213 (-30.4%)	0.0341 (-26.3%)	0.0044 (-30.2%)	0.0035 (-27.1%)
	Sports	0.0230 (-15.8%)	0.0293 (-14.1%)	0.0347 (-16.2%)	0.0539 (-13.3%)	0.0076 (-15.6%)	0.0060 (-13.0%)
LGMRec	Baby	0.0212 (-20.0%)	0.0270 (-18.4%)	0.0322 (-18.5%)	0.0498 (-16.3%)	0.0070 (-18.6%)	0.0055 (-15.4%)
	Clothing	0.0138 (-41.0%)	0.0177 (-39.6%)	0.0208 (-40.9%)	0.0328 (-38.7%)	0.0044 (-39.7%)	0.0034 (-38.2%)
	Sports	0.0252 (-17.6%)	0.0311 (-19.4%)	0.0378 (-19.2%)	0.0557 (-21.5%)	0.0083 (-18.6%)	0.0062 (-20.5%)
MGCN	Baby	0.0213 (-17.8%)	0.0269 (-18.2%)	0.0319 (-16.3%)	0.0491 (-17.5%)	0.0070 (-15.7%)	0.0054 (-16.9%)
	Clothing	0.0146 (-46.5%)	0.0188 (-46.3%)	0.0219 (-47.2%)	0.0348 (-46.5%)	0.0045 (-47.7%)	0.0036 (-46.3%)
	Sports	0.0248 (-23.5%)	0.0316 (-23.3%)	0.0376 (-22.5%)	0.0584 (-22.6%)	0.0083 (-21.7%)	0.0064 (-22.9%)
MMGCN	Baby	0.0132 (-10.8%)	0.0175 (-10.7%)	0.0198 (-8.8%)	0.0329 (-9.9%)	0.0043 (-10.4%)	0.0037 (-9.8%)
	Clothing	0.0063 (-16.0%)	0.0083 (-18.6%)	0.0099 (-16.8%)	0.0162 (-19.8%)	0.0021 (-16.0%)	0.0017 (-19.0%)
	Sports	0.0130 (-18.2%)	0.0172 (-14.4%)	0.0198 (-17.5%)	0.0324 (-12.4%)	0.0045 (-16.7%)	0.0037 (-11.9%)
PGL	Baby	0.0208 (-11.5%)	0.0269 (-12.4%)	0.0315 (-12.7%)	0.0497 (-14.2%)	0.0069 (-12.7%)	0.0055 (-14.1%)
	Clothing	0.0119 (-42.5%)	0.0153 (-43.8%)	0.0182 (-42.8%)	0.0289 (-44.1%)	0.0038 (-42.4%)	0.0030 (-44.4%)
	Sports	0.0237 (-20.2%)	0.0300 (-21.3%)	0.0355 (-19.5%)	0.0550 (-21.1%)	0.0078 (-18.7%)	0.0061 (-19.7%)
SLMRec	Baby	0.0222 (-0.4%)	0.0277 (+0.7%)	0.0331 (-1.2%)	0.0499 (+1.4%)	0.0073 (+0.0%)	0.0055 (+1.9%)
	Clothing	0.0176 (+1.1%)	0.0220 (-2.2%)	0.0268 (+1.1%)	0.0406 (-3.8%)	0.0056 (+1.8%)	0.0042 (-4.5%)
	Sports	0.0284 (-1.4%)	0.0356 (-2.5%)	0.0421 (-1.4%)	0.0640 (-3.5%)	0.0092 (-2.1%)	0.0071 (-2.7%)
SMORE	Baby	0.0214 (-25.2%)	0.0281 (-21.7%)	0.0320 (-24.2%)	0.0523 (-19.2%)	0.0071 (-22.8%)	0.0057 (-19.7%)
	Clothing	0.0167 (-39.5%)	0.0213 (-39.5%)	0.0255 (-39.4%)	0.0399 (-39.0%)	0.0053 (-39.1%)	0.0042 (-38.2%)
	Sports	0.0267 (-18.3%)	0.0337 (-18.6%)	0.0403 (-17.4%)	0.0615 (-18.7%)	0.0088 (-17.8%)	0.0068 (-18.1%)
VBPR	Baby	0.0160 (+0.0%)	0.0210 (-0.5%)	0.0249 (+1.6%)	0.0399 (-0.7%)	0.0055 (+1.9%)	0.0045 (+0.0%)
	Clothing	0.0118 (-0.8%)	0.0149 (-0.7%)	0.0176 (-2.8%)	0.0271 (-2.5%)	0.0037 (-2.6%)	0.0029 (+0.0%)
	Sports	0.0214 (-7.0%)	0.0275 (-6.8%)	0.0320 (-8.3%)	0.0503 (-8.0%)	0.0070 (-9.1%)	0.0056 (-8.2%)

Table 7: Performance Comparison for Method: Image Knockout with Noise.

Model	Dataset	NDCG@5	NDCG@10	Recall@5	Recall@10	Precision@5	Precision@10
BM3	Baby	0.0213 (+0.9%)	0.0276 (+0.4%)	0.0324 (+0.3%)	0.0516 (-0.2%)	0.0071 (+0.0%)	0.0057 (+0.0%)
	Clothing	0.0159 (-5.4%)	0.0200 (-3.8%)	0.0240 (-4.8%)	0.0369 (-1.6%)	0.0050 (-3.8%)	0.0039 (+0.0%)
	Sports	0.0259 (+3.2%)	0.0325 (-0.3%)	0.0384 (+2.7%)	0.0587 (-2.7%)	0.0084 (+3.7%)	0.0064 (-3.0%)
DAMRS	Baby	0.0243 (-4.0%)	0.0314 (-3.7%)	0.0365 (-4.2%)	0.0581 (-3.8%)	0.0080 (-3.6%)	0.0064 (-3.0%)
	Clothing	0.0211 (-9.1%)	0.0269 (-9.1%)	0.0321 (-9.6%)	0.0500 (-9.4%)	0.0067 (-8.2%)	0.0052 (-8.8%)
	Sports	0.0278 (-1.8%)	0.0356 (-1.7%)	0.0420 (-2.6%)	0.0658 (-2.2%)	0.0091 (-3.2%)	0.0072 (-2.7%)
DRAGON	Baby	0.0261 (-3.3%)	0.0330 (-3.5%)	0.0388 (-4.0%)	0.0598 (-4.3%)	0.0084 (-4.5%)	0.0065 (-4.4%)
	Clothing	0.0238 (-10.5%)	0.0301 (-11.5%)	0.0364 (-10.1%)	0.0558 (-12.3%)	0.0075 (-10.7%)	0.0058 (-12.1%)
	Sports	0.0301 (-2.9%)	0.0380 (-5.0%)	0.0458 (-2.3%)	0.0699 (-6.0%)	0.0099 (-3.9%)	0.0077 (-6.1%)
DualGNN	Baby	0.0203 (-3.8%)	0.0268 (+0.0%)	0.0308 (-2.5%)	0.0504 (+2.9%)	0.0067 (-4.3%)	0.0055 (+1.9%)
	Clothing	0.0158 (-8.1%)	0.0203 (-9.0%)	0.0239 (-9.8%)	0.0378 (-10.0%)	0.0050 (-9.1%)	0.0039 (-11.4%)
	Sports	0.0278 (+6.5%)	0.0350 (+6.4%)	0.0419 (+8.5%)	0.0636 (+6.9%)	0.0092 (+8.2%)	0.0070 (+6.1%)
FREEDOM	Baby	0.0250 (-0.8%)	0.0326 (-0.9%)	0.0383 (+0.0%)	0.0615 (-0.3%)	0.0084 (+1.2%)	0.0067 (+0.0%)
	Clothing	0.0247 (-0.8%)	0.0320 (+0.0%)	0.0375 (-1.6%)	0.0602 (+0.7%)	0.0077 (-2.5%)	0.0062 (+0.0%)
	Sports	0.0294 (-7.5%)	0.0379 (-6.0%)	0.0439 (-7.8%)	0.0698 (-5.0%)	0.0096 (-7.7%)	0.0077 (-4.9%)
GRCN	Baby	0.0222 (-3.1%)	0.0292 (+0.0%)	0.0332 (-3.2%)	0.0545 (+2.3%)	0.0073 (-2.7%)	0.0060 (+1.7%)
	Clothing	0.0147 (-14.5%)	0.0191 (-13.6%)	0.0227 (-14.7%)	0.0364 (-12.7%)	0.0047 (-14.5%)	0.0038 (-11.6%)
	Sports	0.0223 (-9.0%)	0.0288 (-6.8%)	0.0328 (-9.1%)	0.0525 (-5.7%)	0.0073 (-8.8%)	0.0058 (-6.5%)
LATTICE	Baby	0.0229 (-0.9%)	0.0295 (+0.0%)	0.0336 (-1.5%)	0.0537 (+0.0%)	0.0074 (-1.3%)	0.0059 (+0.0%)
	Clothing	0.0198 (-1.0%)	0.0245 (-2.4%)	0.0298 (-2.6%)	0.0442 (-4.5%)	0.0061 (-3.2%)	0.0046 (-4.2%)
	Sports	0.0267 (-2.2%)	0.0338 (-0.9%)	0.0401 (-3.1%)	0.0619 (-0.5%)	0.0088 (-2.2%)	0.0068 (-1.4%)
LGMRec	Baby	0.0244 (-7.9%)	0.0318 (-3.9%)	0.0366 (-7.3%)	0.0592 (-0.5%)	0.0080 (-7.0%)	0.0065 (+0.0%)
	Clothing	0.0203 (-13.2%)	0.0259 (-11.6%)	0.0310 (-11.9%)	0.0482 (-9.9%)	0.0064 (-12.3%)	0.0050 (-9.1%)
	Sports	0.0287 (-6.2%)	0.0367 (-4.9%)	0.0436 (-6.8%)	0.0678 (-4.5%)	0.0095 (-6.9%)	0.0074 (-5.1%)
MGCN	Baby	0.0281 (+8.5%)	0.0350 (+6.4%)	0.0415 (+8.9%)	0.0626 (+5.2%)	0.0090 (+8.4%)	0.0068 (+4.6%)
	Clothing	0.0270 (-1.1%)	0.0346 (-1.1%)	0.0411 (-1.0%)	0.0644 (-1.1%)	0.0085 (-1.2%)	0.0067 (+0.0%)
	Sports	0.0327 (+0.9%)	0.0418 (+1.5%)	0.0487 (+0.4%)	0.0764 (+1.2%)	0.0107 (+0.9%)	0.0084 (+1.2%)
MMGCN	Baby	0.0140 (-5.4%)	0.0186 (-5.1%)	0.0211 (-2.8%)	0.0350 (-4.1%)	0.0047 (-2.1%)	0.0039 (-4.9%)
	Clothing	0.0073 (-2.7%)	0.0097 (-4.9%)	0.0116 (-2.5%)	0.0191 (-5.4%)	0.0024 (-4.0%)	0.0020 (-4.8%)
	Sports	0.0138 (-13.2%)	0.0180 (-10.4%)	0.0208 (-13.3%)	0.0335 (-9.5%)	0.0046 (-14.8%)	0.0038 (-9.5%)
PGL	Baby	0.0238 (+1.3%)	0.0313 (+2.0%)	0.0363 (+0.6%)	0.0594 (+2.6%)	0.0079 (+0.0%)	0.0065 (+1.6%)
	Clothing	0.0230 (+11.1%)	0.0296 (+8.8%)	0.0349 (+9.7%)	0.0553 (+7.0%)	0.0072 (+9.1%)	0.0057 (+5.6%)
	Sports	0.0292 (-1.7%)	0.0372 (-2.4%)	0.0442 (+0.2%)	0.0683 (-2.0%)	0.0096 (+0.0%)	0.0075 (-1.3%)
SLMRec	Baby	0.0217 (-2.7%)	0.0270 (-1.8%)	0.0320 (-4.5%)	0.0483 (-1.8%)	0.0070 (-4.1%)	0.0053 (-1.9%)
	Clothing	0.0175 (+0.6%)	0.0223 (-0.9%)	0.0267 (+0.8%)	0.0416 (-1.4%)	0.0055 (+0.0%)	0.0043 (-2.3%)
	Sports	0.0290 (+0.7%)	0.0364 (-0.3%)	0.0427 (+0.0%)	0.0652 (-1.7%)	0.0094 (+0.0%)	0.0072 (-1.4%)
SMORE	Baby	0.0285 (-0.3%)	0.0363 (+1.1%)	0.0420 (-0.5%)	0.0659 (+1.9%)	0.0092 (+0.0%)	0.0072 (+1.4%)
	Clothing	0.0277 (+0.4%)	0.0350 (-0.6%)	0.0422 (+0.2%)	0.0650 (-0.6%)	0.0087 (+0.0%)	0.0067 (-1.5%)
	Sports	0.0330 (+0.9%)	0.0421 (+1.7%)	0.0495 (+1.4%)	0.0772 (+2.1%)	0.0108 (+0.9%)	0.0085 (+2.4%)
VBPR	Baby	0.0171 (+6.9%)	0.0222 (+5.2%)	0.0262 (+6.9%)	0.0418 (+4.0%)	0.0058 (+7.4%)	0.0047 (+4.4%)
	Clothing	0.0112 (-5.9%)	0.0144 (-4.0%)	0.0167 (-7.7%)	0.0266 (-4.3%)	0.0035 (-7.9%)	0.0028 (-3.4%)
	Sports	0.0236 (+2.6%)	0.0298 (+1.0%)	0.0357 (+2.3%)	0.0546 (-0.2%)	0.0079 (+2.6%)	0.0061 (+0.0%)

Table 8: Performance Comparison for Method: Dual Knockout with Constant One.

Model	Dataset	NDCG@5	NDCG@10	Recall@5	Recall@10	Precision@5	Precision@10
BM3	Baby	0.0203 (-3.8%)	0.0266 (-3.3%)	0.0309 (-4.3%)	0.0502 (-2.9%)	0.0068 (-4.2%)	0.0055 (-3.5%)
	Clothing	0.0150 (-10.7%)	0.0191 (-8.2%)	0.0230 (-8.7%)	0.0355 (-5.3%)	0.0048 (-7.7%)	0.0037 (-5.1%)
	Sports	0.0251 (+0.0%)	0.0321 (-1.5%)	0.0377 (+0.8%)	0.0589 (-2.3%)	0.0082 (+1.2%)	0.0065 (-1.5%)
DAMRS	Baby	0.0194 (-23.3%)	0.0255 (-21.8%)	0.0294 (-22.8%)	0.0482 (-20.2%)	0.0065 (-21.7%)	0.0053 (-19.7%)
	Clothing	0.0144 (-37.9%)	0.0184 (-37.8%)	0.0216 (-39.2%)	0.0340 (-38.4%)	0.0046 (-37.0%)	0.0036 (-36.8%)
	Sports	0.0247 (-12.7%)	0.0317 (-12.4%)	0.0368 (-14.6%)	0.0582 (-13.5%)	0.0081 (-13.8%)	0.0064 (-13.5%)
DRAGON	Baby	0.0216 (-20.0%)	0.0285 (-16.7%)	0.0326 (-19.3%)	0.0537 (-14.1%)	0.0072 (-18.2%)	0.0059 (-13.2%)
	Clothing	0.0122 (-54.1%)	0.0158 (-53.5%)	0.0183 (-54.8%)	0.0295 (-53.6%)	0.0038 (-54.8%)	0.0031 (-53.0%)
	Sports	0.0220 (-29.0%)	0.0282 (-29.5%)	0.0327 (-30.3%)	0.0514 (-30.9%)	0.0071 (-31.1%)	0.0057 (-30.5%)
DualGNN	Baby	0.0189 (-10.4%)	0.0245 (-8.6%)	0.0287 (-9.2%)	0.0457 (-6.7%)	0.0064 (-8.6%)	0.0051 (-5.6%)
	Clothing	0.0140 (-18.6%)	0.0178 (-20.2%)	0.0212 (-20.0%)	0.0329 (-21.7%)	0.0044 (-20.0%)	0.0034 (-22.7%)
	Sports	0.0259 (-0.8%)	0.0327 (-0.6%)	0.0378 (-2.1%)	0.0587 (-1.3%)	0.0083 (-2.4%)	0.0065 (-1.5%)
FREEDOM	Baby	0.0190 (-24.6%)	0.0248 (-24.6%)	0.0289 (-24.5%)	0.0466 (-24.5%)	0.0063 (-24.1%)	0.0051 (-23.9%)
	Clothing	0.0134 (-46.2%)	0.0167 (-47.8%)	0.0207 (-45.7%)	0.0309 (-48.3%)	0.0043 (-45.6%)	0.0032 (-48.4%)
	Sports	0.0243 (-23.6%)	0.0308 (-23.6%)	0.0369 (-22.5%)	0.0568 (-22.7%)	0.0081 (-22.1%)	0.0063 (-22.2%)
GRCN	Baby	0.0169 (-26.2%)	0.0225 (-22.9%)	0.0256 (-25.4%)	0.0428 (-19.7%)	0.0057 (-24.0%)	0.0048 (-18.6%)
	Clothing	0.0108 (-37.2%)	0.0144 (-34.8%)	0.0169 (-36.5%)	0.0279 (-33.1%)	0.0035 (-36.4%)	0.0029 (-32.6%)
	Sports	0.0201 (-18.0%)	0.0262 (-15.2%)	0.0303 (-16.1%)	0.0488 (-12.4%)	0.0067 (-16.2%)	0.0054 (-12.9%)
LATTICE	Baby	0.0169 (-26.8%)	0.0215 (-27.1%)	0.0262 (-23.2%)	0.0401 (-25.3%)	0.0058 (-22.7%)	0.0045 (-23.7%)
	Clothing	0.0122 (-39.0%)	0.0156 (-37.8%)	0.0183 (-40.2%)	0.0288 (-37.8%)	0.0038 (-39.7%)	0.0030 (-37.5%)
	Sports	0.0216 (-20.9%)	0.0274 (-19.6%)	0.0326 (-21.3%)	0.0503 (-19.1%)	0.0072 (-20.0%)	0.0056 (-18.8%)
LGMRec	Baby	0.0116 (-56.2%)	0.0148 (-55.3%)	0.0180 (-54.4%)	0.0279 (-53.1%)	0.0039 (-54.7%)	0.0031 (-52.3%)
	Clothing	0.0029 (-87.6%)	0.0039 (-86.7%)	0.0043 (-87.8%)	0.0073 (-86.4%)	0.0009 (-87.7%)	0.0008 (-85.5%)
	Sports	0.0183 (-40.2%)	0.0235 (-39.1%)	0.0275 (-41.2%)	0.0433 (-39.0%)	0.0061 (-40.2%)	0.0048 (-38.5%)
MGCN	Baby	0.0165 (-36.3%)	0.0212 (-35.6%)	0.0248 (-34.9%)	0.0394 (-33.8%)	0.0055 (-33.7%)	0.0044 (-32.3%)
	Clothing	0.0075 (-72.5%)	0.0100 (-71.4%)	0.0116 (-72.0%)	0.0192 (-70.5%)	0.0024 (-72.1%)	0.0020 (-70.1%)
	Sports	0.0169 (-47.8%)	0.0215 (-47.8%)	0.0255 (-47.4%)	0.0394 (-47.8%)	0.0056 (-47.2%)	0.0044 (-47.0%)
MMGCN	Baby	0.0122 (-17.6%)	0.0162 (-17.3%)	0.0190 (-12.4%)	0.0309 (-15.3%)	0.0043 (-10.4%)	0.0035 (-14.6%)
	Clothing	0.0029 (-61.3%)	0.0041 (-59.8%)	0.0042 (-64.7%)	0.0080 (-60.4%)	0.0009 (-64.0%)	0.0008 (-61.9%)
	Sports	0.0113 (-28.9%)	0.0145 (-27.9%)	0.0170 (-29.2%)	0.0269 (-27.3%)	0.0038 (-29.6%)	0.0031 (-26.2%)
PGL	Baby	0.0201 (-14.5%)	0.0260 (-15.3%)	0.0303 (-16.1%)	0.0484 (-16.4%)	0.0067 (-15.2%)	0.0054 (-15.6%)
	Clothing	0.0140 (-32.4%)	0.0180 (-33.8%)	0.0213 (-33.0%)	0.0338 (-34.6%)	0.0044 (-33.3%)	0.0035 (-35.2%)
	Sports	0.0257 (-13.5%)	0.0325 (-14.7%)	0.0385 (-12.7%)	0.0593 (-14.9%)	0.0084 (-12.5%)	0.0065 (-14.5%)
SLMRec	Baby	0.0207 (-7.2%)	0.0260 (-5.5%)	0.0311 (-7.2%)	0.0472 (-4.1%)	0.0068 (-6.8%)	0.0052 (-3.7%)
	Clothing	0.0162 (-6.9%)	0.0205 (-8.9%)	0.0244 (-7.9%)	0.0375 (-11.1%)	0.0051 (-7.3%)	0.0039 (-11.4%)
	Sports	0.0279 (-3.1%)	0.0351 (-3.8%)	0.0415 (-2.8%)	0.0633 (-4.5%)	0.0091 (-3.2%)	0.0070 (-4.1%)
SMORE	Baby	0.0155 (-45.8%)	0.0199 (-44.6%)	0.0233 (-44.8%)	0.0367 (-43.3%)	0.0052 (-43.5%)	0.0041 (-42.3%)
	Clothing	0.0090 (-67.4%)	0.0116 (-67.0%)	0.0139 (-67.0%)	0.0217 (-66.8%)	0.0029 (-66.7%)	0.0023 (-66.2%)
	Sports	0.0176 (-46.2%)	0.0225 (-45.7%)	0.0262 (-46.3%)	0.0411 (-45.6%)	0.0058 (-45.8%)	0.0046 (-44.6%)
VBPR	Baby	0.0163 (+1.9%)	0.0218 (+3.3%)	0.0247 (+0.8%)	0.0412 (+2.5%)	0.0054 (+0.0%)	0.0046 (+2.2%)
	Clothing	0.0130 (+9.2%)	0.0170 (+13.3%)	0.0194 (+7.2%)	0.0316 (+13.7%)	0.0040 (+5.3%)	0.0033 (+13.8%)
	Sports	0.0210 (-8.7%)	0.0273 (-7.5%)	0.0321 (-8.0%)	0.0515 (-5.9%)	0.0071 (-7.8%)	0.0057 (-6.6%)

Table 9: Performance Comparison for Method: Dual Knockout with Constant Zero.

Model	Dataset	NDCG@5	NDCG@10	Recall@5	Recall@10	Precision@5	Precision@10
BM3	Baby	0.0218 (+3.3%)	0.0282 (+2.5%)	0.0331 (+2.5%)	0.0523 (+1.2%)	0.0074 (+4.2%)	0.0058 (+1.8%)
	Clothing	0.0160 (-4.8%)	0.0204 (-1.9%)	0.0241 (-4.4%)	0.0376 (+0.3%)	0.0050 (-3.8%)	0.0039 (+0.0%)
	Sports	0.0254 (+1.2%)	0.0329 (+0.9%)	0.0387 (+3.5%)	0.0617 (+2.3%)	0.0084 (+3.7%)	0.0068 (+3.0%)
DAMRS	Baby	0.0191 (-24.5%)	0.0250 (-23.3%)	0.0288 (-24.4%)	0.0468 (-22.5%)	0.0063 (-24.1%)	0.0051 (-22.7%)
	Clothing	0.0145 (-37.5%)	0.0184 (-37.8%)	0.0222 (-37.5%)	0.0340 (-38.4%)	0.0047 (-35.6%)	0.0036 (-36.8%)
	Sports	0.0235 (-17.0%)	0.0307 (-15.2%)	0.0355 (-17.6%)	0.0572 (-15.0%)	0.0078 (-17.0%)	0.0063 (-14.9%)
DRAGON	Baby	0.0203 (-24.8%)	0.0268 (-21.6%)	0.0307 (-24.0%)	0.0508 (-18.7%)	0.0068 (-22.7%)	0.0056 (-17.6%)
	Clothing	0.0123 (-53.8%)	0.0161 (-52.6%)	0.0185 (-54.3%)	0.0302 (-52.5%)	0.0038 (-54.8%)	0.0032 (-51.5%)
	Sports	0.0219 (-29.4%)	0.0280 (-30.0%)	0.0324 (-30.9%)	0.0510 (-31.5%)	0.0071 (-31.1%)	0.0056 (-31.7%)
DualGNN	Baby	0.0201 (-4.7%)	0.0255 (-4.9%)	0.0302 (-4.4%)	0.0469 (-4.3%)	0.0067 (-4.3%)	0.0052 (-3.7%)
	Clothing	0.0139 (-19.2%)	0.0178 (-20.2%)	0.0211 (-20.4%)	0.0330 (-21.4%)	0.0044 (-20.0%)	0.0034 (-22.7%)
	Sports	0.0261 (+0.0%)	0.0329 (+0.0%)	0.0384 (-0.5%)	0.0593 (-0.3%)	0.0084 (-1.2%)	0.0066 (+0.0%)
FREEDOM	Baby	0.0190 (-24.6%)	0.0248 (-24.6%)	0.0289 (-24.5%)	0.0466 (-24.5%)	0.0063 (-24.1%)	0.0051 (-23.9%)
	Clothing	0.0134 (-46.2%)	0.0167 (-47.8%)	0.0207 (-45.7%)	0.0309 (-48.3%)	0.0043 (-45.6%)	0.0032 (-48.4%)
	Sports	0.0243 (-23.6%)	0.0308 (-23.6%)	0.0369 (-22.5%)	0.0568 (-22.7%)	0.0081 (-22.1%)	0.0063 (-22.2%)
GRCN	Baby	0.0180 (-21.4%)	0.0234 (-19.9%)	0.0271 (-21.0%)	0.0435 (-18.4%)	0.0060 (-20.0%)	0.0049 (-16.9%)
	Clothing	0.0107 (-37.8%)	0.0145 (-34.4%)	0.0163 (-38.7%)	0.0281 (-32.6%)	0.0034 (-38.2%)	0.0029 (-32.6%)
	Sports	0.0206 (-15.9%)	0.0260 (-15.9%)	0.0310 (-14.1%)	0.0476 (-14.5%)	0.0069 (-13.8%)	0.0053 (-14.5%)
LATTICE	Baby	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)
	Clothing	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)
	Sports	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)
LGMRec	Baby	0.0099 (-62.6%)	0.0131 (-60.4%)	0.0152 (-61.5%)	0.0249 (-58.2%)	0.0033 (-61.6%)	0.0027 (-58.5%)
	Clothing	0.0076 (-67.5%)	0.0100 (-65.9%)	0.0118 (-66.5%)	0.0195 (-63.6%)	0.0025 (-65.8%)	0.0020 (-63.6%)
	Sports	0.0208 (-32.0%)	0.0260 (-32.6%)	0.0306 (-34.6%)	0.0465 (-34.5%)	0.0068 (-33.3%)	0.0052 (-33.3%)
MGCN	Baby	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)
	Clothing	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)
	Sports	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)
MMGCN	Baby	0.0123 (-16.9%)	0.0163 (-16.8%)	0.0193 (-11.1%)	0.0314 (-14.0%)	0.0043 (-10.4%)	0.0035 (-14.6%)
	Clothing	0.0029 (-61.3%)	0.0038 (-62.7%)	0.0045 (-62.2%)	0.0075 (-62.9%)	0.0009 (-64.0%)	0.0008 (-61.9%)
	Sports	0.0102 (-35.8%)	0.0133 (-33.8%)	0.0153 (-36.3%)	0.0246 (-33.5%)	0.0035 (-35.2%)	0.0028 (-33.3%)
PGL	Baby	0.0199 (-15.3%)	0.0262 (-14.7%)	0.0297 (-17.7%)	0.0486 (-16.1%)	0.0065 (-17.7%)	0.0054 (-15.6%)
	Clothing	0.0123 (-40.6%)	0.0158 (-41.9%)	0.0189 (-40.6%)	0.0296 (-42.7%)	0.0039 (-40.9%)	0.0031 (-42.6%)
	Sports	0.0237 (-20.2%)	0.0303 (-20.5%)	0.0352 (-20.2%)	0.0552 (-20.8%)	0.0077 (-19.8%)	0.0061 (-19.7%)
SLMRec	Baby	0.0211 (-5.4%)	0.0270 (-1.8%)	0.0309 (-7.8%)	0.0489 (-0.6%)	0.0069 (-5.5%)	0.0054 (+0.0%)
	Clothing	0.0174 (+0.0%)	0.0220 (-2.2%)	0.0265 (+0.0%)	0.0407 (-3.6%)	0.0055 (+0.0%)	0.0042 (-4.5%)
	Sports	0.0276 (-4.2%)	0.0350 (-4.1%)	0.0408 (-4.4%)	0.0631 (-4.8%)	0.0089 (-5.3%)	0.0070 (-4.1%)
SMORE	Baby	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)
	Clothing	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)
	Sports	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)	0.0000 (-100.0%)
VBPR	Baby	0.0005 (-96.9%)	0.0006 (-97.2%)	0.0006 (-97.6%)	0.0009 (-97.8%)	0.0001 (-98.1%)	0.0001 (-97.8%)
	Clothing	0.0002 (-98.3%)	0.0002 (-98.7%)	0.0002 (-98.9%)	0.0004 (-98.6%)	0.0001 (-97.4%)	0.0000 (-100.0%)
	Sports	0.0002 (-99.1%)	0.0002 (-99.3%)	0.0003 (-99.1%)	0.0004 (-99.3%)	0.0001 (-98.7%)	0.0000 (-100.0%)

Table 10: Performance Comparison for Method: ViT-based Visual Embeddings.

Model	Dataset	NDCG@5	NDCG@10	Recall@5	Recall@10	Precision@5	Precision@10
BM3	Baby	0.0217 (+2.8%)	0.0277 (+0.7%)	0.0328 (+1.5%)	0.0511 (-1.2%)	0.0072 (+1.4%)	0.0056 (-1.8%)
	Clothing	0.0167 (-0.6%)	0.0209 (+0.5%)	0.0254 (+0.8%)	0.0381 (+1.6%)	0.0053 (+1.9%)	0.0040 (+2.6%)
	Sports	0.0256 (+2.0%)	0.0322 (-1.2%)	0.0383 (+2.4%)	0.0586 (-2.8%)	0.0084 (+3.7%)	0.0065 (-1.5%)
DAMRS	Baby	0.0255 (+0.8%)	0.0326 (+0.0%)	0.0390 (+2.4%)	0.0606 (+0.3%)	0.0085 (+2.4%)	0.0066 (+0.0%)
	Clothing	0.0237 (+2.2%)	0.0305 (+3.0%)	0.0361 (+1.7%)	0.0570 (+3.3%)	0.0074 (+1.4%)	0.0059 (+3.5%)
	Sports	0.0280 (-1.1%)	0.0362 (+0.0%)	0.0421 (-2.3%)	0.0674 (+0.1%)	0.0092 (-2.1%)	0.0074 (+0.0%)
DRAGON	Baby	0.0235 (-13.0%)	0.0304 (-11.1%)	0.0361 (-10.6%)	0.0572 (-8.5%)	0.0079 (-10.2%)	0.0063 (-7.4%)
	Clothing	0.0267 (+0.4%)	0.0338 (-0.6%)	0.0409 (+1.0%)	0.0629 (-1.1%)	0.0085 (+1.2%)	0.0065 (-1.5%)
	Sports	0.0294 (-5.2%)	0.0379 (-5.2%)	0.0438 (-6.6%)	0.0699 (-6.0%)	0.0096 (-6.8%)	0.0077 (-6.1%)
DualGNN	Baby	0.0212 (+0.5%)	0.0275 (+2.6%)	0.0315 (-0.3%)	0.0508 (+3.7%)	0.0069 (-1.4%)	0.0056 (+3.7%)
	Clothing	0.0187 (+8.7%)	0.0239 (+7.2%)	0.0284 (+7.2%)	0.0444 (+5.7%)	0.0059 (+7.3%)	0.0046 (+4.5%)
	Sports	0.0261 (+0.0%)	0.0331 (+0.6%)	0.0391 (+1.3%)	0.0605 (+1.7%)	0.0087 (+2.4%)	0.0067 (+1.5%)
FREEDOM	Baby	0.0251 (-0.4%)	0.0326 (-0.9%)	0.0382 (-0.3%)	0.0612 (-0.8%)	0.0083 (+0.0%)	0.0067 (+0.0%)
	Clothing	0.0252 (+1.2%)	0.0326 (+1.9%)	0.0386 (+1.3%)	0.0613 (+2.5%)	0.0080 (+1.3%)	0.0063 (+1.6%)
	Sports	0.0314 (-1.3%)	0.0400 (-0.7%)	0.0471 (-1.1%)	0.0731 (-0.5%)	0.0102 (-1.9%)	0.0080 (-1.2%)
GRCN	Baby	0.0230 (+0.4%)	0.0297 (+1.7%)	0.0339 (-1.2%)	0.0541 (+1.5%)	0.0074 (-1.3%)	0.0060 (+1.7%)
	Clothing	0.0176 (+2.3%)	0.0228 (+3.2%)	0.0268 (+0.8%)	0.0428 (+2.6%)	0.0055 (+0.0%)	0.0044 (+2.3%)
	Sports	0.0251 (+2.4%)	0.0318 (+2.9%)	0.0371 (+2.8%)	0.0577 (+3.6%)	0.0082 (+2.5%)	0.0064 (+3.2%)
LATTICE	Baby	0.0233 (+0.9%)	0.0295 (+0.0%)	0.0346 (+1.5%)	0.0538 (+0.2%)	0.0076 (+1.3%)	0.0059 (+0.0%)
	Clothing	0.0206 (+3.0%)	0.0261 (+4.0%)	0.0311 (+1.6%)	0.0480 (+3.7%)	0.0064 (+1.6%)	0.0050 (+4.2%)
	Sports	0.0264 (-3.3%)	0.0335 (-1.8%)	0.0399 (-3.6%)	0.0615 (-1.1%)	0.0087 (-3.3%)	0.0068 (-1.4%)
LGMRec	Baby	0.0268 (+1.1%)	0.0336 (+1.5%)	0.0404 (+2.3%)	0.0612 (+2.9%)	0.0088 (+2.3%)	0.0067 (+3.1%)
	Clothing	0.0210 (-10.3%)	0.0270 (-7.8%)	0.0320 (-9.1%)	0.0506 (-5.4%)	0.0067 (-8.2%)	0.0052 (-5.5%)
	Sports	0.0288 (-5.9%)	0.0370 (-4.1%)	0.0437 (-6.6%)	0.0688 (-3.1%)	0.0096 (-5.9%)	0.0076 (-2.6%)
MGCN	Baby	0.0272 (+5.0%)	0.0342 (+4.0%)	0.0408 (+7.1%)	0.0621 (+4.4%)	0.0090 (+8.4%)	0.0068 (+4.6%)
	Clothing	0.0278 (+1.8%)	0.0355 (+1.4%)	0.0425 (+2.4%)	0.0661 (+1.5%)	0.0088 (+2.3%)	0.0068 (+1.5%)
	Sports	0.0326 (+0.6%)	0.0413 (+0.2%)	0.0490 (+1.0%)	0.0755 (+0.0%)	0.0107 (+0.9%)	0.0083 (+0.0%)
MMGCN	Baby	0.0143 (-3.4%)	0.0191 (-2.6%)	0.0215 (-0.9%)	0.0357 (-2.2%)	0.0048 (+0.0%)	0.0041 (+0.0%)
	Clothing	0.0071 (-5.3%)	0.0093 (-8.8%)	0.0114 (-4.2%)	0.0183 (-9.4%)	0.0024 (-4.0%)	0.0019 (-9.5%)
	Sports	0.0152 (-4.4%)	0.0198 (-1.5%)	0.0234 (-2.5%)	0.0374 (+1.1%)	0.0052 (-3.7%)	0.0042 (+0.0%)
PGL	Baby	0.0252 (+7.2%)	0.0324 (+5.5%)	0.0384 (+6.4%)	0.0604 (+4.3%)	0.0084 (+6.3%)	0.0066 (+3.1%)
	Clothing	0.0222 (+7.2%)	0.0286 (+5.1%)	0.0337 (+6.0%)	0.0536 (+3.7%)	0.0070 (+6.1%)	0.0056 (+3.7%)
	Sports	0.0299 (+0.7%)	0.0380 (-0.3%)	0.0449 (+1.8%)	0.0698 (+0.1%)	0.0098 (+2.1%)	0.0076 (+0.0%)
SLMRec	Baby	0.0226 (+1.3%)	0.0287 (+4.4%)	0.0336 (+0.3%)	0.0521 (+5.9%)	0.0073 (+0.0%)	0.0057 (+5.6%)
	Clothing	0.0181 (+4.0%)	0.0230 (+2.2%)	0.0277 (+4.5%)	0.0431 (+2.1%)	0.0057 (+3.6%)	0.0045 (+2.3%)
	Sports	0.0286 (-0.7%)	0.0364 (-0.3%)	0.0430 (+0.7%)	0.0669 (+0.9%)	0.0094 (+0.0%)	0.0074 (+1.4%)
SMORE	Baby	0.0290 (+1.4%)	0.0363 (+1.1%)	0.0434 (+2.8%)	0.0657 (+1.5%)	0.0095 (+3.3%)	0.0072 (+1.4%)
	Clothing	0.0277 (+0.4%)	0.0349 (-0.9%)	0.0425 (+1.0%)	0.0646 (-1.2%)	0.0088 (+1.1%)	0.0067 (-1.5%)
	Sports	0.0320 (-2.1%)	0.0413 (-0.2%)	0.0481 (-1.4%)	0.0765 (+1.2%)	0.0105 (-1.9%)	0.0084 (+1.2%)
VBPR	Baby	0.0002 (-98.8%)	0.0004 (-98.1%)	0.0005 (-98.0%)	0.0010 (-97.5%)	0.0001 (-98.1%)	0.0001 (-97.8%)
	Clothing	0.0002 (-98.3%)	0.0002 (-98.7%)	0.0003 (-98.3%)	0.0005 (-98.2%)	0.0001 (-97.4%)	0.0001 (-96.6%)
	Sports	0.0001 (-99.6%)	0.0002 (-99.3%)	0.0001 (-99.7%)	0.0003 (-99.5%)	0.0000 (-100.0%)	0.0000 (-100.0%)

Table 11: Performance Comparison for Method: Llava-generated Image Captions.

Model	Dataset	NDCG@5	NDCG@10	Recall@5	Recall@10	Precision@5	Precision@10
BM3	Baby	0.0212 (+0.5%)	0.0277 (+0.7%)	0.0320 (-0.9%)	0.0516 (-0.2%)	0.0071 (+0.0%)	0.0057 (+0.0%)
	Clothing	0.0169 (+0.6%)	0.0213 (+2.4%)	0.0252 (+0.0%)	0.0389 (+3.7%)	0.0053 (+1.9%)	0.0041 (+5.1%)
	Sports	0.0250 (-0.4%)	0.0319 (-2.1%)	0.0373 (-0.3%)	0.0583 (-3.3%)	0.0082 (+1.2%)	0.0064 (-3.0%)
DAMRS	Baby	0.0245 (-3.2%)	0.0311 (-4.6%)	0.0368 (-3.4%)	0.0570 (-5.6%)	0.0080 (-3.6%)	0.0063 (-4.5%)
	Clothing	0.0213 (-8.2%)	0.0272 (-8.1%)	0.0323 (-9.0%)	0.0505 (-8.5%)	0.0067 (-8.2%)	0.0052 (-8.8%)
	Sports	0.0282 (-0.4%)	0.0362 (+0.0%)	0.0431 (+0.0%)	0.0673 (+0.0%)	0.0094 (+0.0%)	0.0074 (+0.0%)
DRAGON	Baby	0.0247 (-8.5%)	0.0319 (-6.7%)	0.0376 (-6.9%)	0.0595 (-4.8%)	0.0081 (-8.0%)	0.0065 (-4.4%)
	Clothing	0.0244 (-9.8%)	0.0306 (-10.0%)	0.0364 (-10.1%)	0.0567 (-10.8%)	0.0075 (-10.7%)	0.0059 (-10.6%)
	Sports	0.0309 (-0.3%)	0.0399 (-0.3%)	0.0467 (-0.4%)	0.0742 (-0.3%)	0.0102 (-1.0%)	0.0082 (+0.0%)
DualGNN	Baby	0.0201 (-4.7%)	0.0262 (-2.2%)	0.0303 (-4.1%)	0.0488 (-0.4%)	0.0066 (-5.7%)	0.0054 (+0.0%)
	Clothing	0.0154 (-10.5%)	0.0200 (-10.3%)	0.0239 (-9.8%)	0.0380 (-9.5%)	0.0050 (-9.1%)	0.0040 (-9.1%)
	Sports	0.0260 (-0.4%)	0.0330 (+0.3%)	0.0386 (+0.0%)	0.0597 (+0.3%)	0.0085 (+0.0%)	0.0066 (+0.0%)
FREEDOM	Baby	0.0248 (-1.6%)	0.0321 (-2.4%)	0.0379 (-1.0%)	0.0605 (-1.9%)	0.0083 (+0.0%)	0.0066 (-1.5%)
	Clothing	0.0247 (-0.8%)	0.0316 (-1.2%)	0.0381 (+0.0%)	0.0596 (-0.3%)	0.0079 (+0.0%)	0.0062 (+0.0%)
	Sports	0.0314 (-1.3%)	0.0401 (-0.5%)	0.0468 (-1.7%)	0.0733 (-0.3%)	0.0102 (-1.9%)	0.0080 (-1.2%)
GRCN	Baby	0.0226 (-1.3%)	0.0284 (-2.7%)	0.0332 (-3.2%)	0.0509 (-4.5%)	0.0073 (-2.7%)	0.0056 (-5.1%)
	Clothing	0.0147 (-14.5%)	0.0191 (-13.6%)	0.0222 (-16.5%)	0.0361 (-13.4%)	0.0046 (-16.4%)	0.0038 (-11.6%)
	Sports	0.0242 (-1.2%)	0.0308 (-0.3%)	0.0359 (-0.6%)	0.0559 (+0.4%)	0.0079 (-1.2%)	0.0062 (+0.0%)
LATTICE	Baby	0.0228 (-1.3%)	0.0289 (-2.0%)	0.0342 (+0.3%)	0.0528 (-1.7%)	0.0075 (+0.0%)	0.0058 (-1.7%)
	Sports	0.0273 (+0.0%)	0.0341 (+0.0%)	0.0415 (+0.2%)	0.0622 (+0.0%)	0.0091 (+1.1%)	0.0069 (+0.0%)
LGMRec	Baby	0.0241 (-9.1%)	0.0308 (-6.9%)	0.0364 (-7.8%)	0.0570 (-4.2%)	0.0079 (-8.1%)	0.0063 (-3.1%)
	Clothing	0.0184 (-21.4%)	0.0234 (-20.1%)	0.0282 (-19.9%)	0.0437 (-18.3%)	0.0058 (-20.5%)	0.0045 (-18.2%)
	Sports	0.0299 (-2.3%)	0.0381 (-1.3%)	0.0452 (-3.4%)	0.0703 (-1.0%)	0.0099 (-2.9%)	0.0077 (-1.3%)
MGCN	Baby	0.0280 (+8.1%)	0.0350 (+6.4%)	0.0411 (+7.9%)	0.0624 (+4.9%)	0.0090 (+8.4%)	0.0068 (+4.6%)
	Clothing	0.0270 (-1.1%)	0.0345 (-1.4%)	0.0416 (+0.2%)	0.0648 (-0.5%)	0.0086 (+0.0%)	0.0067 (+0.0%)
	Sports	0.0325 (+0.3%)	0.0412 (+0.0%)	0.0488 (+0.6%)	0.0755 (+0.0%)	0.0107 (+0.9%)	0.0083 (+0.0%)
MMGCN	Baby	0.0139 (-6.1%)	0.0189 (-3.6%)	0.0211 (-2.8%)	0.0362 (-0.8%)	0.0047 (-2.1%)	0.0041 (+0.0%)
	Clothing	0.0066 (-12.0%)	0.0089 (-12.7%)	0.0103 (-13.4%)	0.0173 (-14.4%)	0.0022 (-12.0%)	0.0018 (-14.3%)
	Sports	0.0153 (-3.8%)	0.0199 (-1.0%)	0.0233 (-2.9%)	0.0373 (+0.8%)	0.0052 (-3.7%)	0.0042 (+0.0%)
PGL	Baby	0.0237 (+0.9%)	0.0312 (+1.6%)	0.0360 (-0.3%)	0.0590 (+1.9%)	0.0079 (+0.0%)	0.0065 (+1.6%)
	Clothing	0.0217 (+4.8%)	0.0278 (+2.2%)	0.0334 (+5.0%)	0.0521 (+0.8%)	0.0069 (+4.5%)	0.0054 (+0.0%)
	Sports	0.0300 (+1.0%)	0.0380 (-0.3%)	0.0449 (+1.8%)	0.0693 (-0.6%)	0.0097 (+1.0%)	0.0076 (+0.0%)
SLMRec	Baby	0.0216 (-3.1%)	0.0273 (-0.7%)	0.0315 (-6.0%)	0.0488 (-0.8%)	0.0069 (-5.5%)	0.0054 (+0.0%)
	Clothing	0.0171 (-1.7%)	0.0218 (-3.1%)	0.0263 (-0.8%)	0.0409 (-3.1%)	0.0055 (+0.0%)	0.0043 (-2.3%)
	Sports	0.0288 (+0.0%)	0.0365 (+0.0%)	0.0426 (-0.2%)	0.0660 (-0.5%)	0.0094 (+0.0%)	0.0073 (+0.0%)
SMORE	Baby	0.0289 (+1.0%)	0.0369 (+2.8%)	0.0419 (-0.7%)	0.0665 (+2.8%)	0.0092 (+0.0%)	0.0073 (+2.8%)
	Clothing	0.0269 (-2.5%)	0.0342 (-2.8%)	0.0408 (-3.1%)	0.0633 (-3.2%)	0.0085 (-2.3%)	0.0066 (-2.9%)
	Sports	0.0327 (+0.0%)	0.0415 (+0.2%)	0.0488 (+0.0%)	0.0758 (+0.3%)	0.0107 (+0.0%)	0.0083 (+0.0%)
VBPR	Baby	0.0002 (-98.8%)	0.0004 (-98.1%)	0.0003 (-98.8%)	0.0011 (-97.3%)	0.0001 (-98.1%)	0.0001 (-97.8%)
	Clothing	0.0004 (-96.6%)	0.0006 (-96.0%)	0.0008 (-95.6%)	0.0013 (-95.3%)	0.0002 (-94.7%)	0.0001 (-96.6%)
	Sports	0.0230 (+0.0%)	0.0295 (+0.0%)	0.0349 (+0.0%)	0.0547 (+0.0%)	0.0077 (+0.0%)	0.0061 (+0.0%)