TU GRAZ SCIENCE FOR FUTURE

2022: DIGITAL VISIONS

# Towards Fair-AI: A Study on Popularity Bias in News Recommendations

## ONLINE STUDY

**START:** 27th of October, 2020
**END:** 9th of November, 2020
**USE-CASE:** Related News Articles


**Significant Key Events:**
**E1:** Vienna Terror Attack (November 2nd)

**E2:** Death of Sean Connery and COVID-19 Lockdown Announcement in Austria (October 31st)

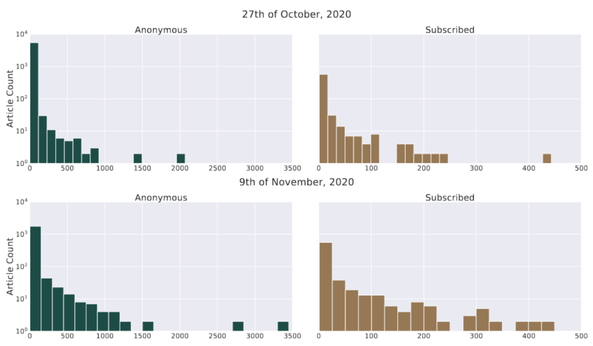
## CONCLUSIONS

**C1:** The **probability** of recommendations **to be seen** is the **highest** for **desktop** devices

**C2:** The **probability** of **clicking** the recommendations (once they are seen) is the **highest** for **mobile** devices

**C3:** The reading behavior of **subscribed users** is **less prone** to **popularity bias** when compared to anonymous users

**C4:** Personalized, content-based news recommendations lead to a **more balanced distribution** of news articles' **readership popularity**, especially for **anonymous** users




**C5:** Significant **key events** cause for notable **fluctuations** of the recommender performance (Vienna Terror Attack)

**C6:** Personalisation can contribute to fair AI principles but **we need more sophisticated measures to measure fairness!**

## EXPERIMENTS

**Objective 1**: Comparing the performance of news recommendations for different user interface types

**Recommendation-Seen-Ratio (RSR)** is defined as the ratio between the number of times the user actually saw recommendations (i.e., scrolled to the respective UI section) and the number of recommendations that were generated for a user.

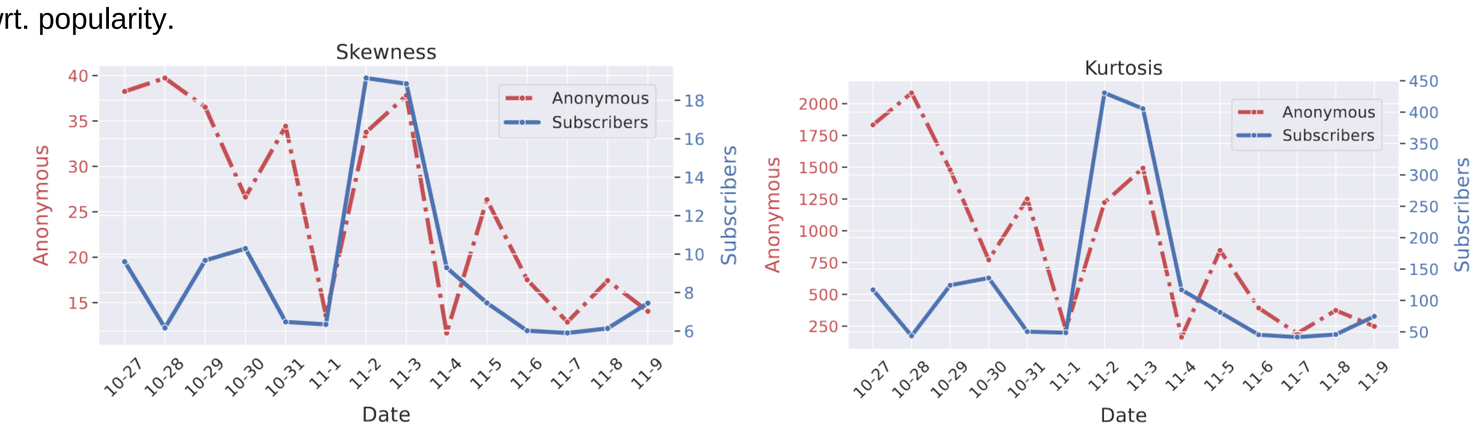
**Click-Through-Rate (CTR)** is measured by the ratio between the number of actually clicked recommendations and the number of seen recommendations.


| % | Desktop | Mobile | Tablet |
|---|---|---|---|
| RSR | **26.88** | 17.55 | 26.71 |
| CTR | 10.53 | **13.40** | 11.37 |


**Objective 2:** Mitigating popularity bias by introducing personalized, content-based news recommendations

**Skewness** measures the asymmetry of a probability distribution. A high value depicts a right-tailed distribution, i.e., indicates biased news consumption wrt. popularity.

**Kurtosis** measures the "tailedness" of a distribution. Higher values indicate a higher tendency for popularity bias.




A large **gap** exists between **anonymous** users and **subscribers** at the **beginning** of the **study**. **Only most-popular** recommendations were shown to the users at that time. A **considerably lower difference** between the user groups is achieved at the end of the study, **which leads to more fairness for unpopular articles.**

## DATA STATISTICS

**Interface Types:** Desktop, Mobile and Tablet

**User Groups:** Anonymous and logged-in Subscribers

| Measure | User Group | Desktop | Mobile | Tablet | Sum |
|---|---|---|---|---|---|
| No. of (users) / sessions | Anonymous | 205,703 | 925,000 | 52,209 | 1,182,912 |
| | Subscribers | (8,650) 14,136 | (5,758) 7,712 | (1,502) 1,873 | (15,910) 23,721 |
| | Sum | 219,839 | 932,712 | 54,082 | 1,206,633 |
| No. of distinct news articles | Anonymous | 14,002 | 6,631 | 3,552 | 17,028 |
| | Subscribers | 2,977 | 1,904 | 1,353 | 3,238 |
| | Sum | 14,378 | 6,711 | 3,645 | 17,372 |
| No. of reads | Anonymous | 474,855 | 1,802,197 | 94,399 | 2,371,451 |
| | Subscribers | 168,035 | 110,268 | 17,113 | 295,416 |
| | Sum | 642,890 | 1,912,465 | 111,532 | 2,666,887 |

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**Open PhD position on fair and sequence-aware recommender systems**

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