Studying Confirmation Bias in Hashtag Usage on Twitter

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Goal

- **Confirmation bias and filter bubble effects** are a current problem in social platforms such as Twitter.
- The heavy **reuse of hashtags** that are popular in the personal Twitter networks (i.e., own hashtags or hashtags of followees) can foster these effects.
- We study confirmation bias in Twitter by treating the **reuse of hashtags as a proxy for confirmation bias**.

Method

1. **We crawl two datasets from Twitter**, where *CompSci* consists of researchers from the field of computer science and their followees, while dataset consists of random people and their followees (see **dataset statictics** table below).
2. For all the seed users (i.e., $|U_S|$), we analyze **(i) individual hashtag reuse** (i.e., reusing own hashtags), and **(ii) social hashtag reuse** (i.e., reusing hashtags of followees) with respect to hashtag usage types (see **Result 1**) and temporal effects (see **Result 2**).
3. We analyze how **hashtag recommendation algorithms** are affected by confirmation bias (see **Result 3**) and how these effects could be tackled (see **Discussion**).

Dataset	$\|U_S\|$	$\|U\|$	$\|T\|$	$\|HTAS\|$
CompSci	2,551	91,776	5,649,359	9,161,842
Random	3,466	127,112	8,157,702	13,628,750

Discussion

- **Accurate recommendations foster hashtag reuse** and thus, confirmation bias and filter bubbles effects in our two Twitter datasets.
- We should focus on **beyond-accuracy metrics of recommender systems** such as diversity and serendipity.
- See our other poster: **"Mitigating Confirmation Bias on Twitter by Recommending Opposing Views"**.

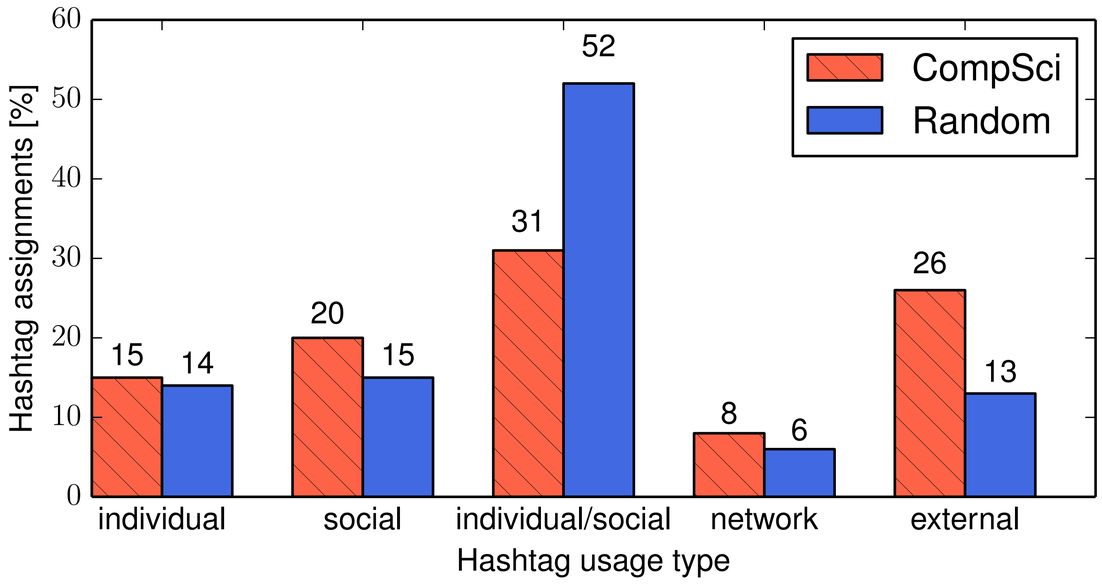
Full Paper & Framework

[1] Kowald, D., Pujari, S., and Lex, E. Temporal effects on hashtag reuse in Twitter: A cognitive-inspired hashtag recommendation approach. In *Proc. of WWW'2017*. ACM.
[2] Kowald, D., Kopeinik, S., and Lex., E. The TagRec Framework as a Toolkit for the Development of Tag-Based Recommender Systems. In *Proc. of UMAP'2017*. ACM.

https://github.com/learning-layers/TagRec/

Result 1: Individual and Social Hashtag Reuse

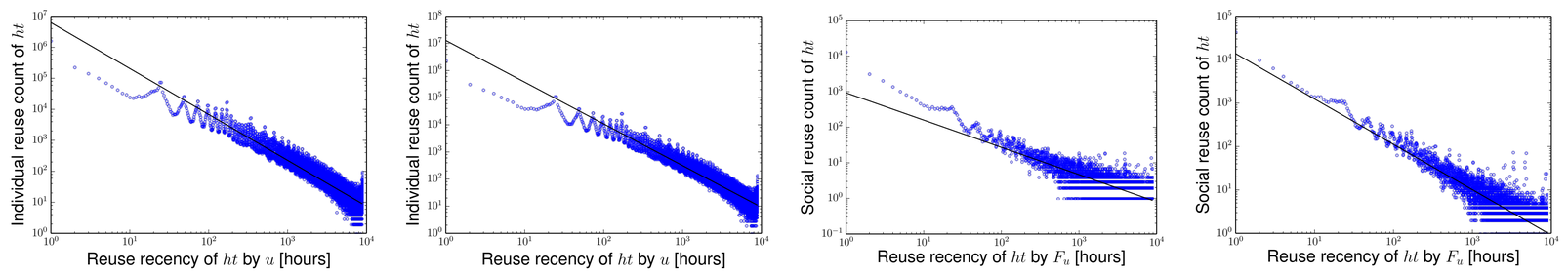
Is their a relationship between confirmation bias and the usage of hashtags in Twitter? Or: do people tend to reuse their own hashtags and/or the hashtags of their followees?



We find that between **66% and 81% of hashtag assignments** can be explained by **individual or social hashtag usage** (i.e., the sum of "individual", "social" and "individual/social"). **This is an indication of confirmation bias in hashtag usage on Twitter**.

Result 2: Temporal Effects on Hashtag Reuse

Are temporal effects affecting this confirmation bias? Or: do people tend to reuse hashtags that were used recently by their own and/or their followees?

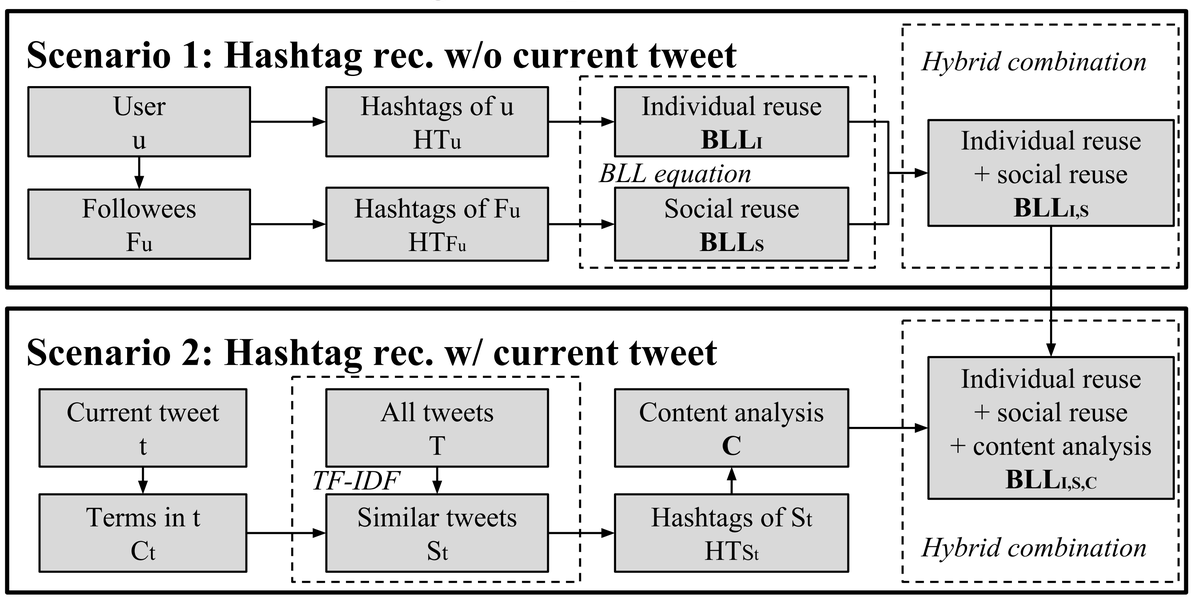


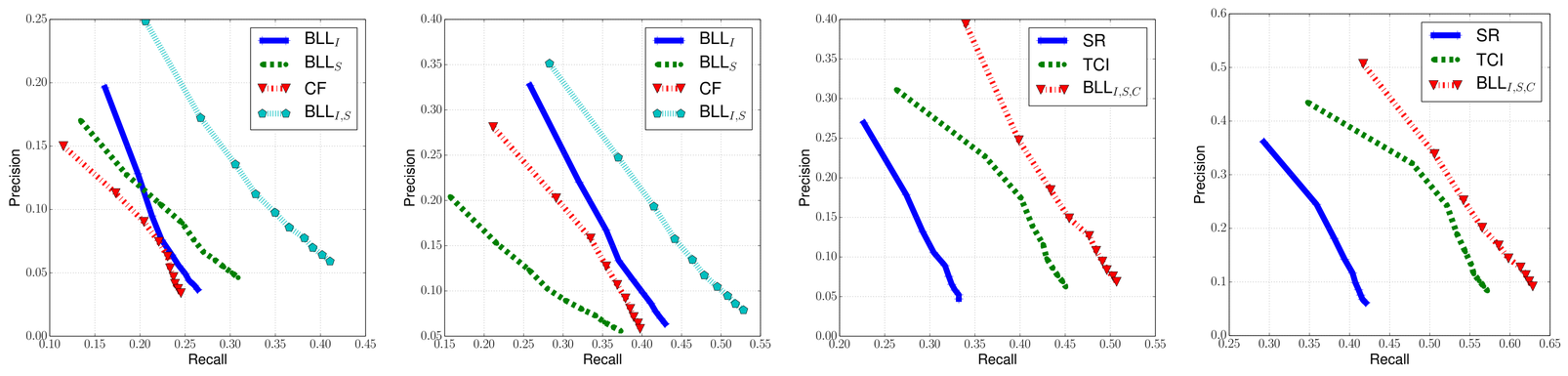
(a) Individual hashtag reuse *CompSci* dataset (b) Individual hashtag reuse *Random* dataset (c) Social hashtag reuse *CompSci* dataset (d) Social hashtag reuse *Random* dataset

People tend to reuse hashtags that were used **very recently by their own and/or by their Twitter followees**. According to a Likelihood-Ratio test, **a power function is better suited to model this time-dependent decay than an exponential one.**

Result 3: Hashtag Recommendations in Twitter

Are hashtag recommendation algorithms affected by this confirmation bias? Or: does an algorithm that focuses on hashtag reuse provide accurate recommendations?





(a) *Scenario 1*: *CompSci* (b) *Scenario 1*: *Random* (c) *Scenario 2*: *CompSci* (d) *Scenario 2*: *Random*

Our **cognitive-inspired hashtag recommendation** approach, which focuses on hashtag reuse, provides the best results with respect to **prediction accuracy**.