

# On the Dynamics of Username Changing Behavior on Twitter

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## ABSTRACT

People extensively use *username* to lookup users, their profiles and tweets that mention them via Twitter search engine. Often, the searched username is outdated due to a recent *username change* and no longer refers to the user of interest. Search by the user's old username results in a failed attempt to reach the user's profile, thereby making others falsely believe that the user account has been deactivated. Such search can also redirect to a different user who later picks the old username, thereby reaching to a different person altogether. Past studies show that a substantial section of Twitter users change their username over time. We also observe similar trends when tracked 8.7 million users on Twitter for a duration of two months. To this point, little is known about how and why do these users undergo changes to their username, given the consequences of unreachability. To answer this, we analyze username changing behavior of carefully selected users on Twitter and find that users change username frequently within short time intervals (a day) and choose new username un-related to the old one. Few favor a username by repeatedly choosing it multiple times. We explore few of the many reasons that may have caused username changes. We believe that studying username changing behavior can help correctly find the user of interest in addition to learning username creation strategies and uncovering plausible malicious intentions for the username change.

## 1. INTRODUCTION

About 200 million users registered on Twitter by 2013, making it the most populous micro-blogging service.<sup>1</sup> Users join Twitter via an easy sign-up process where they choose their profile attributes. One of these attributes, *username* can help find and identify a user uniquely on the network. Twitter further assigns a unique, numeric, and constant *ID* to the user after the sign up process is complete. User ID can only be known to other users via an API request, and not via Twitter web / mobile interface. Out of two unique attributes of the user – username and user ID, changes to only username are allowed.<sup>2</sup> Allowing changes to username may assist users to ac-

commodate their changing requirements over time. However, such username changes may lead to unwanted consequences.

Twitter search engine receives about 2.1 billion queries every day asking about events, celebrities and users.<sup>3</sup> A section of these queries have a username that finds user<sup>4</sup> who owns the username [1]. Sometimes, the searched username is the user's old username due to a recent username change. With no information of the user ID, a user search with her old username may lead to non-searchability (no results) or unreachability (broken link) to the user's profile [2]. Few users who change usernames may not know the consequences of failed search but others reportedly take this as an opportunity to abscond themselves from stalkers or investigators. A pro-Islamic State (IS) account of Asawitiri Media is a prime example. The account has made many death threats to Twitter co-founder Jack Dorsey and Twitter CEO Dick Costolo. Asawitiri Media's account, along with many others like it, use strategies to escape tracking and suspension. In one of Asawitiri Media's tweets, he suggests to change Twitter username and the picture multiple times a day. This retains the accounts' followers but the stalkers and investigators will see a broken link every time they search with an outdated username [3]. Search with an old username of a user can also direct to a different user, if someone else picks the old username. This can cause confusion among people searching for the user [4].

Changes to any profile attribute other than username do not lead to unreachability to the user profile. Hence, in this work, we focus only on *username changing behavior* on Twitter. Liu *et al.*, in a longitudinal study of Twitter, observed that 3% of 376 million users changed their usernames over time [5]. In our dataset of 8.7 million Twitter users tracked for two months, we observe that about 73.21% users change their profile attributes and assign new values (see Figure 1). About 10% of users change their username (discussed in Section 3).

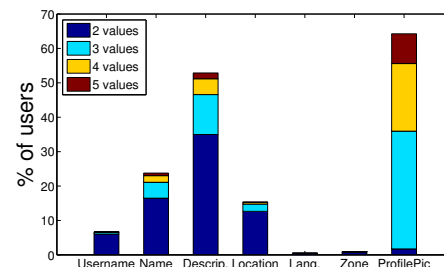


Figure 1: Around 73.21% of 8.7 million users change their attributes on Twitter; about 10% change their username.

<sup>1</sup><https://blog.twitter.com/2013/celebrating-twitter7>

<sup>2</sup><https://support.twitter.com/articles/14609-changing-your-username>

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<sup>3</sup><http://www.jeffbullas.com/2013/10/09/60-sensational-social-media-facts-and-statistics-on-twitter-in-2013/>

<sup>4</sup><https://support.twitter.com/articles/14022>

Questions on *how*, *why* and *who* are these user accounts that frequently change their username on Twitter are, so far, unanswered. We believe that answering *how users create usernames over time* can aid in finding a user's account on other social networks. Username creation methods to create usernames over time can replicate and re-occur while creating usernames on her other accounts. Literature and our prior work devise profile linking methods that can link user accounts assuming usernames are created in the similar fashion within and across networks over time [6, 7]. Answering *who are these users* and *why do they change usernames* can help us understand if the username changing behavior is a characteristic of a specific set of users. Finding reasons for username change can indicate if the intentions are benign and valid or fraudulent.

In this study, we make a first attempt to answer these questions and characterize username changing behavior on Twitter. We carefully create a dataset of 10K users, randomly sampled from 8.7 million users, and track them for a duration of 14 months every fifteen minutes. We analyze the characteristics of users as well as usernames. Our analysis reveal that:

- Twenty percent of users trigger 85% of username changes; observed to change five time or more. **Username changing behavior follows Pareto principle.** Ten percent username changes occur after an hour (20% after a day) of the earlier username change.
- **Sixty five percent of users choose a new username unrelated to the old one** while thirty five percent re-use an old one sometime later.
- Reasons to change username include benign reasons like space gain, suit a trending event, gain / lose anonymity, adjust to real-life events, avoid boredom and malicious intentions like obscured username promotion and username squatting.

With recorded past usernames of the users, Twitter can benefit in effectively redirecting user search queries rather than either serving with a dead link or different user. With understanding of patterns and reasons of username change, Twitter can also develop tailored username suggestion algorithms for its benign users during the sign up process and later. The paper is organized as follows. We first discuss background and related research, followed by a detailed data collection methodology. We then discuss characteristics of usernames created as well as of users who changed usernames, and then explore some plausible reasons for such behavior. We then discuss the implications of our observations, and conclude the paper with limitations and future directions.

## 2. RELATED WORK

A user's profile on a social network is composed of variety of attributes like name, location, posts, and friends. These attributes change over time as the user relocates, explores new interests, and meets new friends. Studying changes to these attributes can help trace the user's history and help various applications to cater to new likings and moving patterns of the user.

**Evolving User Behavior:** Researchers have studied user's posts over time and suggest that few topics of posts remain consistent due to user's inherent interests while new topics evolve due to breaking events, and news from social circles [8]. User's location has been studied to note patterns of relocation in order to find her other social network profiles, assumed to exhibit similar patterns of relocation [9]. Evolution of friends, new connections and involvement in groups, recent friends has been studied in [10, 11] and is used for matching profiles of users across networks [12]. Our work contributes to the extend the understanding of evolution of the unique

identifiable attribute of users i.e. username.

**Profile Linking:** Temporal changes to profile, post or connection attributes help users to reflect their changing requirements. Collective data over time could be helpful to understand the user and model the user better. A plausible application of temporal data is to linking profiles of user across social networks. **Pioneering studies by Perito *et al.* and Zafarani *et al.* show that by using unique attribute of the user – username, it is possible to achieve good accuracy on profile linking.** To an extent, the studies aimed to model user behavior of creating usernames and assumed similar behavior on other social networks [6, 13]. However, both the studies assumed prior access to a set of user profiles known to belong to the user across networks in order to extract usernames and model the username creation behavior. We, however, collect usernames created within a single social network i.e. Twitter and initiate research on understanding username creation behavior using history of attributes within a social network. This work helps in characterizing username changing behavior, capturing important facts about user preferences while choosing new usernames, and believe that such a characterization can help profile linking.

**Identifying Malicious Users:** Extensive research has devised methods to identify fake followers [14], and spam accounts [15]. Devised methods analyze profiles, tweeting behavior, URLs, redirections, followers and connection network to identify a malicious or anomalous behavior. Only few studies examine the temporal aspects of these users and include them as a feature for malicious user detection [16]. Our work of tracking an account's Twitter username and understand if the reasons for frequent username changes are benign or fraudulent intend to contribute to identification of malicious user accounts.

## 3. DATA COLLECTION

Our data collection methodology is divided in stages. We first create a large seed set, track the seed set for two months every fortnight, find users who change usernames more often than others, filtered these users and track their profiles every fifteen minutes for a longer stretch of 14 months.

**Seed Set:** In order to access any changes to username, we needed to track users as Twitter API does not provide any notification whenever there are any changes. Users are selected at random to generalize the analysis on Twitter. However, we chose not to track inactive users since it is unlikely of them to change their username (or any profile attribute). **We, therefore, selected a seed set of 8,767,576 users who participated in 17 local and global events during April 1, 2013 - September 3, 2013 recorded by an event monitoring tool, MultiOSN [17]. Hereon, we refer to the seed set of 8,767,576 users as 8.7M users.**

**Seed Tracking:** We tracked 8.7M users for any username changes, by querying them every fortnight within a period of October 1, 2013 - November 26, 2013, via Twitter Search API. Table 1 describes the numbers. By comparing two consecutive scans, old and new usernames of a user were recorded. Twitter usernames are case-insensitive, therefore any case changes were not counted as username changes. We found that 853,827 users of 8.7M users (10%) changed their usernames at least once during a small observation period of two months. However, querying 8.7M users lacked necessary data such as exact timestamp of username change and all username changes made by a user during the observation period. The reason being long scan stretches of four to five days each time

to query 8.7M users using limited Twitter API calls.

**Seed Filtering:** To capture the actual time and date when users changed their usernames as well as capture most username changes triggered by users, we needed to scan 8.7M users at short intervals. Quicker scans would need 1,462 application authentication tokens. We, therefore, used limited authentication tokens to respect the Twitter API resources utilization and initiated a fifteen-minute scan. We consciously aimed at selecting users who have exhibited username changing behavior in the past and are more likely to repeat the same in future. We think that tracking users who do not participate in such behavior add little value. We, therefore, filtered 711,609 users who changed their usernames at least once and randomly sampled 10,000 users<sup>5</sup> to monitor them at short intervals.

**Dataset:** We query 10K users via Twitter API every 15 minutes. We term the faster scan of 10K users as *Fifteen-minute scan*. Fifteen-minute scan starts on Nov 22, '13; we bookmark the scan till Jan 22, '15 and use 14 months scan for our analysis.

Name of scan	Period of scan	# users
Fortnight scan	Oct 16 '13 - Nov 26, '13	8,767,576
Fifteen-minute scan	Nov 22 '13 - Jan 22 '15	10,000

Table 1: Dataset statistics.

## 4. CHARACTERIZATION

Before analyzing the characteristics of the entities involved in username changing process – usernames and users, we estimate the frequency of the behavior. Out of 10K users, 4,198 users changed their usernames at least once in 14 months, constituting 14,880 username changes. About 20% users changed five times or more triggering around 12,648 (85% of all) username changes (see Figure 3). One user changed her username 113 times in 14 months which on manual inspection, turned out to be an inorganic user [18] with half completed tweets, tweets with same text, and frequent posts in short duration. We also examine the number of days after which users trigger the change (see Figure 2(a)). Around 20% of username changes were triggered within a day of the previous username change. Observe a Pareto distribution with 20% users frequently changing usernames in short intervals and 80% users changing rarely after long durations (see inset figure in Figure 3).

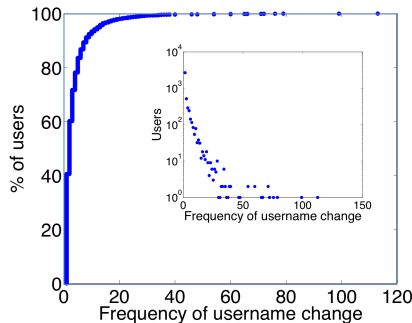


Figure 3: User distribution for frequency of changing username. Twenty percent users frequently change usernames and 80% users change rarely.

<sup>5</sup>We are continuously collecting data for the 711,609 users and hope to have a larger dataset soon.

## 4.1 Usernames

An action of username change involves dumping an old username and creating a new one. Often, users favorite a username and repeatedly use that username. In our dataset, we find that around 35% of users reuse an old username later while 65% never do so. In order to understand distinct username creation patterns, we filter out reused usernames and considered only unique usernames used by the users over time. We first investigate how the usernames differ from each other. To measure the similarity between two consecutive usernames used by a user, we use Longest Common Subsequence (LCS) similarity, a well-defined metric in literature.

LCS similarity estimates the sequence of characters that appear together without penalizing for insertions made. Figure 2(b) shows the cumulative distribution of username changes vs LCS matching length between the usernames (old and new) associated with the change. LCS matching length is normalized by length longer of the two, as suggested in literature [6]. For approximately 82% of username changes, new username is un-related to the old username ( $\text{length} \leq 0.5$ ) while for around less than 10% changes have new usernames highly similar and derived from the old ones ( $\text{length} \geq 0.8$ ). The observation indicates that majority of users select dissimilar usernames over of time within one social network, which is a complementary observation to literature which suggests that users create similar usernames across other social network sites [6, 13]. Note that such a user behavior may repeat as well across social networks and hence could challenge profile linking methods that use traditional string matching algorithms to match usernames in order to find connection between two user profiles.

Observe that users alter characters either in center, start of end of the their old username. This implies that users exhibit certain preferences of when and how they wish to create and alter usernames. The preferences can be taken into account to modify the failed search with the outdated username and for profile linking across networks (see Figure 2).

## 4.2 Users

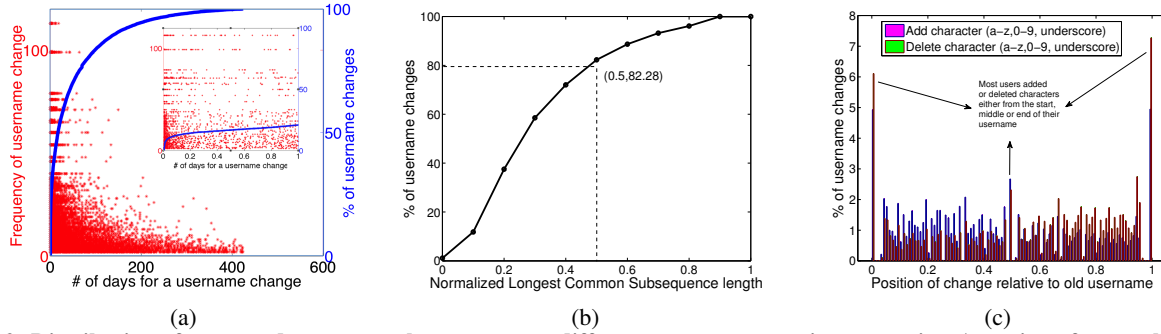
We now explore the characteristics of users who opt to change their usernames. Does their popularity or activity or familiarity with network govern the frequency of username change? We answer these questions now.

### 4.2.1 Popularity v/s Frequency of Change

On Twitter, users tweet, reply or converse with their username. Changing usernames by a popular user may lead to confusion among her followers or may lead to loss of tweets in case someone else picks the username. In such a scenario, we speculate that users with higher number of followers avoid any username changes. We measure popularity of 4,198 users using followers (in-degree) and plot it against frequency of username change (see Figure 4(a)). To find correlation between the two, we remove users with too many followers ( $> 1$  million) or too less ( $< 1$ ). We observe that username change frequency is weakly yet positively correlated to the in-degree of the user (Pearson correlation: 0.1153,  $p$ -value  $< 0.00001$ ,  $\alpha: 0.05$ ). A significant positive correlation imply that higher the popularity, higher is the frequency of change, however weak correlation does not guarantee the same.

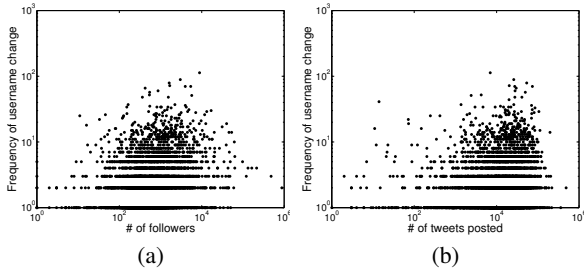
### 4.2.2 Activity v/s Frequency of Change

An active user on Twitter, who engages herself in conversations and group chats, may change her username less frequently to avoid confusion during tagging / replying in a tweet. We conjecture that active users change their usernames less frequently. We analyze 4,198 users and measure their activity with the number of created



**Figure 2: Distribution of users and username changes among different username creation strategies. A section of users change their username multiple times within short intervals and choose un-related new usernames. Users are likely to alter old username by adding or deleting only characters at preferred positions.**

tweets. Figure 4(b) shows the frequency of username change with the user’s activity. To find correlation between the two, we removed users with too many tweets ( $> 100K$ ) or too few ( $< 1$ ). We observe a weak and positive correlation between the two (*Pearson correlation: 0.1045,  $p$ -value  $< 0.0001$ ,  $\alpha: 0.05$* ). A positive yet weak correlation imply that users with high activity are inclined towards frequent username changes, however activity does not guarantee frequency.



**Figure 4: Frequency of username change vs user popularity and activity. Weak correlations imply that popularity and activity has a little impact on the choice of changing username.**

#### 4.2.3 Familiarity v/s Frequency of Change

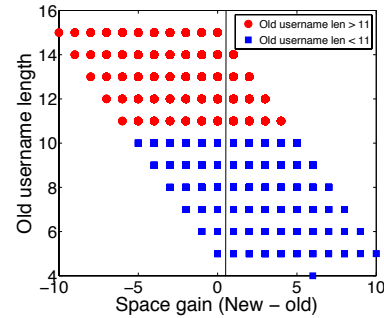
Intuitively, users who registered long time ago are familiar with Twitter and must have chosen stable and beneficial username for themselves than users who have registered recently and are still in exploratory stage. We examine if old user accounts engage themselves in username changing behavior or only new users change their usernames multiple times. A negative and very weak correlation between the age of the Twitter account and the frequency with which the account changes username (*Pearson correlation: -0.0942,  $p$ -value  $< 0.0001$ ,  $\alpha: 0.05$* ) implies that both older and newer accounts engage in this behavior.

## 5. PLAUSIBLE REASONS

So far it is unclear on reasons that encourage users to change their usernames. Users put efforts to create a suitable username to converse with others on the network. A sudden change to the username directs users to a broken link or to a different user altogether who now owns the dumped username. We now discuss a set of reasons for username change based on observations using data analysis and talking informally to tracked users via tweets.

**Space Gain:** On Twitter, a user can converse with another user by tagging her '@<username>' in 140-character tweet. Since the

tweet length is limited and maximum character limit for username is 15 characters, long usernames imply short message. We speculate that users with long old usernames may change to short new usernames to allow other users (followers) to post more content than before and benefit from space gain. This reason is motivated by the introduction of shortened urls and RT symbol in Twitter to save space in a tweet [19]. We calculate the length difference between new and old username of users and separately represent users with old usernames less than and greater than the median length (11). We observe that 75.19% of long usernames moved to short or same length new usernames while 60.87% short usernames picked long new usernames (see Figure 5). In other words, most users with old usernames of length  $< 11$  tend to add characters in their new usernames while most users with old usernames of length  $\geq 11$  prefer to remove characters for their new usernames. With this observation, we infer that creating shorter usernames is an incentive for users to change usernames.



**Figure 5: Length difference between new and old username v/s length of old username. Users with long usernames pick shorter new usernames (higher negative space gain) while users with short usernames pick longer new usernames.**

**Maintain Multiple Accounts:** Few exchange usernames with their multiple accounts. A user is allowed to manage and create multiple accounts with different email address. We think that by tracing shared username’s owners over time may help link multiple accounts of a single user within Twitter.

**Change Username Identifiability:** Few users in our dataset changed usernames to reverse the identifiability of the usernames i.e. either to make them personal or anonymous. For instance, a user named ‘loried ligarreto’ changed her username from ‘loriedligarreto’ to ‘sienteteotravez’ (feel again in English) implying that user possibly intended to make her username anonymous. In other instances, we observe users who previously picked less identifiable usernames,



ID	Scan - I	Scan - II	Scan - III	Group	Date of observation
60xx2762x	Peshawar_sMs	MoBiLe_TricKes	BBC_PAK_NEWS	Sajan Group	2013-04-08
11xx37099x	Vip_Wife	Peshawar_sMs	UBL_Cricket	Sajan Group	2013-10-25
28xx1645x	NFS002cric	NaKaaM_LiFe	Peshawar_sMs	Sajan Group	2013-11-08

**Table 2: Obscured username promotion.** Users of a group (partner accounts) collaboratively share and promote the username via tweets / description to evenly distribute followers among themselves.

made them personal later. For example, a user named ‘rodrigo’ changed her username from ‘unosojosverdes’ (green eyes in English) to ‘rodrigothomas\_’, thereby implicating that user probably wished to associate her real identity to her username.

**Adjust to Events:** Another user told us in a tweet that she represents Sahara India FabClub. She has supported Sahara’s Pune Warriors team in IPL event with username ‘pwifanclub’ and then Sahara F1 team with username ‘ForceIndia@!’ and therefore has changed her username.

**Obscured Username Promotion:** Owing to limited number of users in fifteen minute scan, we use fortnight scans of 8.7M users for this analysis. To our surprise, we find that a few user profiles collaboratively picked the same username at different times. Table 2 shows one such group and the rotation of a username among the profiles, as observed in four scans. Username ‘Peshawar\_sMs’ was used by different user IDs at different times. All these users claimed to belong to a group, either in their name or in bio attribute. We term the username which is shared by multiple accounts as *shared username* and profiles who picked the shared username at different times as *partner accounts*. We observe 70 other shared usernames in our fortnight scans. We inspect the intentions for such a behavior in following ways.

We analyze tweets and description of the partner accounts mentioned in Table 2. We calculate number of ‘@’ tags mentioned in their tweets and description. It was surprising to see that irrespective of the group, the partner accounts promoted a shared username by posting “Follow @<username>” in their tweets (or in description) multiple times (see Figure 6). Altogether for the two groups under observation, ten accounts promoted 30 other usernames. Seventeen percent (5 out of 30) usernames are promoted by more than one user. We think that by asking other Twitter users to follow a shared username and then keep exchanging the username with each other, the intention is to obscure the real identity of the user behind the free flowing shared username and distribute the followers evenly across the partner accounts.



**Figure 6: A partner account promotes another in her tweet.**

We explain the username promotion methodology as: an account holds a shared username  $u_s$  while other partner accounts promote the username by asking users to follow the account with username  $u_s$ . The account gains followers and decides to let her partner accounts gain further. She then releases her username to be picked by her partner accounts, and picks another (shared) username. She starts the promotion of the username  $u_s$ , along with other partner accounts. Her partner account who picked  $u_s$  then gain followers. For the accounts mentioned in Table 2, a username is repeatedly

picked by the partner accounts with fewer followers. A similar modus operandi was observed when Recorded Future<sup>6</sup> analyzed Twitter accounts of a terrorist organization, Islamic State (IS). A single username was promoted by multiple ISIS-related accounts or followers either via bio or tweets, thereby tricking and gaining followers [20]. We suspect that the accounts listed in Table 2 engage in similar malicious activities.

**Username Squatting:** On Twitter, if an inactive user account keeps the username, in order to block or preserve that username, and not to allow others to use it, the username belongs to squatted-username. Username squatting is against Twitter Rules.<sup>7</sup> Squatted usernames on OSNs have been investigated as a challenge in literature by law researchers [21] to fight cases of trademark infringement. We are curious to find if users change usernames in order to squat interesting ones. Method to squatting here is to create profiles that either show no activity (i.e. no tweets) or have zero followers. For our fifteen-minute scan, we observe that for around 12% of 4,198 users, at least one of their vacated usernames are blocked by inactive Twitter profiles, either created by themselves or others. Without the access to emails used to create user accounts, it is difficult to validate if users created the accounts to squat the usernames or others block the username with an inactive account.

We think that future research can add these observations as features to find malign / phoney users on platforms like Twitter.

## 6. DISCUSSION

This work aims at finding how and why users change their usernames within a social network like Twitter. Most users created new username un-related to the old username when they changed username within a social network. We think that un-related usernames over time could be credited to the absence of cognitive load to remember a past dumped username [6]. When creating username across OSNs, a user needs to remember all usernames but while creating usernames within a network, she needs to remember only the latest one. Therefore, she has the liberty to choose it to be different from others. Un-relatedness between old and new usernames may challenge people on the network to derive new username from a user’s old username and use Twitter search engine to find her.

Leaving other users in a dilemma of finding her new profile is what one may not intend to do, therefore, it is less expected of users to change their usernames at the first place. However, our analysis suggests that a section of users changed usernames for reasons, such as to help current followers write more in a tweet by reserving less space with the new shorter username, intentionally share a username with other members of a group to evenly distribute followers among themselves, anonymize or personalize their profile, exhibit their support towards a team / event, etc. Based on an informal survey, we verified the reasons we speculated. We think that either users are not aware of missed searches due to username change or they care less.

We also inquire if similar reasons for change exist for other social networks that allow username change any number of times. Wikipedia is a moderated platform which allows changes to user-

<sup>6</sup><https://www.recordedfuture.com/>

<sup>7</sup><https://support.twitter.com/articles/18311>

Reason Category	Example	% of users
Privacy	"For privacy, since Sstrieu has my initials and part of my full name."	21%
Privacy and Abuse	"For privacy. Ive attracted the attention of online bullies lately."	9%
Link All Accounts	"Consistency with other logins across the whole range of places where one can login, including some publicly accessible online profiles (e.g. Twitter)."	6%
Use Real Name	"Changing my account from my nickname to my real name"	4%
Use Easier, Shorter Username	"This username is easier to remember for me"	12%
Spelling, Capitalization, Spacing issues	"Didn't realize there could be a space in the username"	17%
Violates Wiki Policy [Promotional]	"My username is promotional/advertising for [[Roblox]] and administrator said either change your username or make a new account, so I am requesting to change my name."	2%
Violates Wiki Policy [Group Usage]	"Current username represents organisation"	10%
Violates Wiki Policy [Religious Connotation]	"My current name is apparently too ethnic for some editors, leading to inappropriate talk page speculation about my religion."	6%
Violates Wiki Policy [Bot]	"Didnt read username policy, not allowed to have Bot in username."	2%
Violates Wiki Policy [Offensive]	"Was told username may be offensive to some, and a violation of username policy."	2%
No / Random Reason	"I would like a username in English, please"	9%

**Table 3: Examples of few reasons for username change listed on Wikipedia.**

names. Every time a Wiki member wants to change username, she needs to request a moderator with her old username, wished new username and the reason for change. We collated 16,167 reasons from 15,288 Wiki members listed within 6 years i.e., from December 20, 2007 to December 20, 2013, publicly available here<sup>8</sup>. Reasons are described as free text, so we used grounded theory and classified the reasons in categories based on Wiki policies of username creation<sup>9</sup>. Table 3 shows the categories and the distribution of reasons within each category. We observe that 22% users request for a username change as their old username is not in accordance with Wikipedia's username policy, 30% users change to gain anonymity and avoid abuse, few for unified identity, adjust to spelling errors and capitalization. Few examples for username change are mentioned in Table 3. Study of username change on two networks, Twitter and Wikipedia, show that few users are concerned about their privacy while others want to establish their unique identity across platforms. Few other reasons are platform specific e.g. username promotion on Twitter to gain followers while username change on Wikipedia to adjust to platform's policy.

## 7. LIMITATIONS AND FUTURE WORK

Due to limited Twitter API resources, we monitored a small set (10K) of Twitter users at short intervals of 15 minutes and recorded 4,198 users who changed their usernames in 14 months. We understand that our dataset captures a small population out of million Twitter users. However, our intention is to highlight observations about username changing behavior over time. We further attempt to reason the change by informally asking users for feedback via writing tweets to them. As we received few responses, we could not list reasons of all username changes we observed.

We suggest to extend the work in two directions. First, we suggest a detailed investigation of their behavior, connections and tweeting patterns of users who form groups and rotate username to understand their intentions. Second, we plan to extend the dataset to prove the validity and generalizability of derived inferences.

## 8. ACKNOWLEDGEMENT

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