

Analyzing Rule Changes in Reddit Communities

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1 Data

Our analysis used data taken from two snapshots of Reddit that captured 186725 subreddits: the first was scraped in April 2020 (including 180376 subreddits) and the second was scraped December of 2020 (175609 subreddits). These scrapes included generic community metadata as well as the data stored in the “Rules Widget.” Each rule in the Rules Widget has a name, description, and violation reason. They also have creation timestamps.

Of the 169260 subreddits that were in both scrapes, subreddits that had fewer than three subscribers in both scrapes (accounting for 32316 subreddits) or that were founded within a month of the first scrape (4891 subreddits) were filtered out. 1202 subs were missing their rules widget, age information, or subscriber counts, and were dropped. With the remaining subs, we identified rules that were the same between snapshots if they had the same creation timestamp and description or the same rule name.

The final dataset contains 130851 subs. The subs have between 1 to 15 rules, with the middle 50% having 2–5 rules. The subs are between 0 to 15.25 years old, with the middle 50% being 0.92 to 4.08 years old. The final dataset contains a total of 525018 rules. The rules are between 0 to 6 years old, with the middle 50% being 0.56 to 1.46 years old.

1.1 Categorization of Rule Change

Due to Reddit’s user interface, each rule has multiple forms: a short name (the name displayed on the subreddit’s main page), a description (a more detailed explanation of the rule) and a violation reason (which moderators use to flag posts that violate the rules, and users see on flagged posts). Rules have to be initialized with a rule name, but can leave the violation reason and description field blank, or simply copy the rule name into those fields. Violation reasons and descriptions that were blank (the default for descriptions) or identical to the rule name (the default for violation reasons) were considered missing, since those are default values.

Text analysis was done on the version of the rule in the first snapshot and the second snapshot to determine how rules in each subreddit changed between snapshots. Each field could be assigned four labels: unchanged, added, deleted, or changed. Below is a description of how those labels were assigned for rule names.

1. **unchanged**: Rules that were present in both snapshots, where the Levenshtein distance of the rule name between snapshots was less than 5. This threshold excluded minor typo corrections or formatting changes from being counted as the kind of substantive rule change we are interested in. Roughly 499000 of 525000 rule changes fit this criterion.
2. **added**: Rules that were present in the second snapshot and not the first.
3. **deleted**: Rules that were present in the first snapshot and not the second.
4. **changed**: Rules that were present in both snapshots, where the Levenshtein distance of the rule name between snapshots was greater than 5.

We needed a unique identifier for each rule to distinguish between a situation where the rule's name is modified and a situation where the rule is deleted and a new one is created. We used the rule's creation timestamp to distinguish between these two situations; if a rule in the first snapshot had the exact same creation timestamp as the second, we considered it to be the same rule.

Violation reasons and rule descriptions were labelled identically to rule names; however, the threshold for Levenshtein differences was increased to 10 for rule descriptions because they are generally longer, and descriptions and violation reasons were considered added or deleted if they changed between default and non-default texts.

1.2 Focusing on Rule Names

Table 1: Description and violation reasons are rarely independently altered.

Change Type	Rule Name	Rule Description	Violation Reason
unchanged	498079	396668	141875
added	—	434	523
deleted	—	148	168
changed	676	5518	454
total	525018	402768	143020

This table shows the changes in text fields for the rules that were present in both snapshots, so that we can examine how rule descriptions and violation reasons changed independently of rule names. The rule name additions and deletions are defined as rules that were only in one or the other snapshot, so they do not have an entry in the table, but there were 16705 rule additions and 9558 deletions.

Table 1 shows the changes in text fields for the rules that were present in both snapshots, so that we can examine how rule descriptions and violation reasons changed independently of rule names. 0.04% of rule descriptions were deleted, 0.11% were added, and 1.37% were changed. 0.37% of the violation reasons were

added, 0.12% were deleted and 0.32% were changed. Because violation reasons and descriptions were added and deleted less than 1% of the time, we focused our analysis on rule-level additions, deletions, and changes, which can be tracked through the rule names. The rest of this report focuses on the rule name field.

2 Hypotheses

- H1 Community rules change by accretion rather than revision**, which we would expect to see if rule change is mostly occurring as new situations that previous rules don't apply to come up. In this case, we would see the majority of rule changes being additions rather than changes.
- H2 Large changes to a community's rules will be rare compared to incremental changes**, because internet communities change their regulations gradually as communities age or grow. In this case, we will see that single rule additions, deletions, and changes within a community will be more common than large combinations of additions, deletions, and changes. The opposite case would indicate that rule change follows a punctuated equilibrium pattern, where there are periods of relative stability followed by short periods of large rule change.
- H3 Incremental changes will tend to be rule additions** if communities are likely to experience new situations that require governance and therefore adopt a new rule. We'd expect the opposite to be true if communities are more likely to outgrow rules and therefore delete an outdated rule.
- H4 The more initial rules the subreddit has, the greater percentage of their rules will be deleted**, because subreddits that liberally create many rules are less likely to create rules that withstand the test of time. We can explore this hypothesis by looking at the ratio of rules deleted to the initial rules, to see how the relative percentage of deletions changes with initial rule size.
- H5 The more initial rules in the subreddit, the the less the percentage of their rules corpus would be added**, which would be true subreddits that initially create a more comprehensive rule set have less of a need for new rules. Alternately, subreddits that create many rules initially might generally be more willing to enforce governance and create rules, in which case we would expect to see the percentage of rule additions increasing with the number of initial rules.
- H6 The bigger the subreddit, the more rules they will add**, because as a subreddit grows there are more opportunities for new kinds of dialogue or behavior that requires governance to take place. This hypothesis would be supported if we saw rule additions increasing with a subreddit's subscriber count.

- H7 The bigger the subreddit, the more rules they will delete.** which we would expect if there are rules that become outdated or function less well as communities get larger. We would expect the opposite to be true if communities tried to keep their original rules very consistent as they grew.
- H8 The older the rule, the more likely it is to be deleted.** We expect to see this if, as a rule ages, the likelihood of it becoming outdated or obsolete increases; in this case, deletions would increase with rule age. Alternately, if older rules are more likely to withstand the test of time and therefore be unchanging, we would expect to see younger rules getting deleted more often.
- H9 The older the subreddit, the more rules they will add.** This could be true if as communities mature, they are more willing to enforce and update policies, in which case we would expect to see rule additions increasing with the subreddit's age. Alternately, subreddits could be unwilling to introduce new rules to older communities.
- H10 The older the subreddit, the more rules they will delete.** We would expect to see deletions increasing with the subreddit's age.

3 Methods

For hypothesis 1, we can use a χ^2 frequency distribution test to see if there is a significant difference in the number of rules that were unchanged, added, deleted, or changed. Similarly, for hypothesis 2 we can use a χ^2 frequency distribution test to see if there is a significant difference in the number of subreddits that added/deleted/changed a single rule and the subreddits that added/deleted/changed a rule along with changing at least one other rule. For hypothesis 3 we can use a χ^2 test to see if there is a significant difference between the number of subs that added a single rule, the number of subs that deleted a single rule, and the number of subs that changed a single rule.

To understand community-level correlates of rule change, we regressed rule name additions, and deletions against community attributes. We used BIC-based model comparisons to compare several model forms, including linear regression, logistic regression (by binarizing the data), Poisson regression, and negative binomial regression. Negative binomial regression performed the best on the continuous data because a disproportionately high number of rules were unchanged.

For hypotheses 4-7 and 9-10 we used a negative binomial regression model with independent variables being community age, number of subscribers, and number of initial rules along with their pairwise combinations, and the dependant variable being the number of rules deleted (**H4**, **H7**, and **H10**), or the number of rules added (**H5**, **H6**, and **H9**).

To understand rule-level correlates of rule change, we also used logistic regression to explore the relationship between rule age and the rule's status in the second snapshot. We tested **H8** by training a logistic regression model with rule age as the

independent variable and the rule's status as either deleted or not deleted as the predicted variable.

4 Results

4.1 Overall Change in the Rules Corpus (H1)

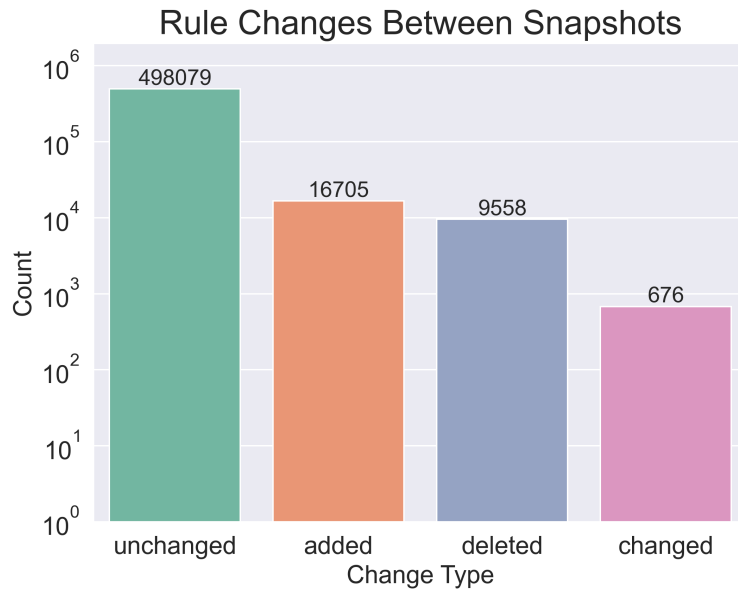


Figure 1: We can see that the vast majority of rules are unchanged between snapshots. The majority of rule changes occur as additions. The y axis is log-scaled, so the number of rules that were unchanged is ten times greater than the number of rules that were added and a hundred times greater than the number of rules that were changed.

We can look at the total counts for each type of rule change to test whether community rules are changing by accretion or deletion. The vast majority of rules (498079) were unchanged between the snapshots. Out of the 26939 rules that had activity, 16705 (62%) were added, making additions by far the most frequent type of rule activity. 9558 rules (35%) were deleted. Actual change of the rule name is the rarest type of rule activity; 676 rules (only 3%) were changed. Figure 1 indicates that the overall corpus of subreddit rules is increasing over time. The χ^2 test supported **H1**, with a χ^2 statistic of 1367896 and a p-value < 0.001 . Most rule change is occurring to increase governance within communities, with the total rules corpus growing over time.

4.2 Relating change size and change type (H2 & H3)

According to hypothesis 2, we expect to see gradual incremental change taking place in subreddits more often than large changes as they grow. Of the 130851 subreddits included in this study, 2360 had incremental change (i.e. they only added, deleted, or changed a single rule between snapshots). On the other hand, 4588 subs had some kind of combined change, where more than one rule was altered between snapshots. Almost twice as many subs changed had combined changed compared to incremental change; this is evidence against **H2** and suggests that rule change follows a pattern similar to punctuated equilibrium, where many rules are changed in a short window of time. The χ^2 test confirmed that the difference between the number of incremental rule changes and the number of combined rule changes was significant for additions, deletions, and changes (all three tests had a χ^2 statistic > 110000 and a p-value < 0.001).

The pie chart on the left of Figure 2 shows the breakdown of change types for the subs that had incremental change. In line with **H3**, we see that the majority of incremental changes happened by rule additions. The χ^2 test showed a significant difference between the rule change types amongst the subreddits that had incremental changes, with a χ^2 value of 126221 and a p-value < 0.001. 83% of incremental changes were additions, whereas only 18% of the subs that had combined rule changes combined other rule changes with a single rule addition (Figure 2). Whereas incremental change is additive, combinations of change appear to be more revisionary, often involving a rule being deleted.

4.3 Relating Initial Rules and Rule Change (H4 & H5)

The number of rules subreddits had in the first snapshot can function as an indicator for the level of governance and oversight practiced by a subreddit. Relating initial rules to rule change allows us to test hypotheses 4 and 5. We found that subreddits that had more rules in the first scrape deleted a proportionally higher percentage of their rules. In Figure 3 we can see that the ratio between the number of rules a subreddit deletes and the number of rules it had in the first snapshot increases with the number of rules from the first snapshot, peaking at around 7% deletion. There is a significant jump in the ratio for subs that had 10 or more initial rules. **H4** posits that the percentage of rule deletions will increase in communities with more initial rules. This finding suggests that Reddit communities that were initially more liberal with the length of their rules corpus were also more liberal about removing rules from the corpus, indicating that our hypothesis was correct.

Interestingly, the relationship between rule additions and initial rules does not seem to continuously increase (Figure 4). There is an initial spike of 5% rule additions for subreddits that had 1 rule in the first Reddit scrape. These could have been subs that had only started adding rules recently before the first snapshot, or subs that were initially overly restrictive about the rules they created. There is a relative plateau of between 2-3% rule additions for subreddits that had 2-7 initial rules. With 8 or more rules, the ratio of rule additions to initial rules is generally between 5-6%, with a dip at 9 initial rules and a spike at 13. Subs with

Incremental and Combined Rule Changes

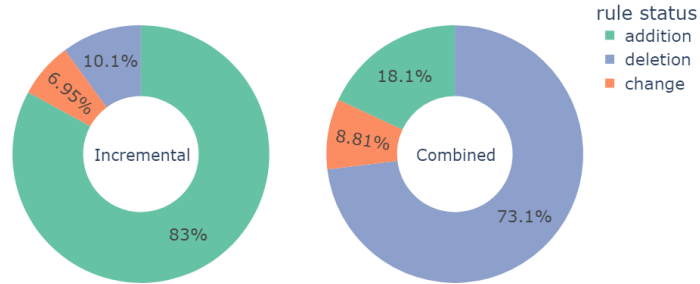


Figure 2: The pie chart on the left shows that the majority of incremental changes in subreddits happen by rule additions. Each slice corresponds to the number of subreddits that only changed their rules corpus by either adding, deleting, or changing a single rule. The pie chart on the right shows that the majority of combined changes in subreddits are triggered by rule deletions. Each slice corresponds to the number of subreddits that either added, deleted, or changed a single rule, and also added/deleted/changed at least one other rule. For example, the green segment shows that 18% of subreddits added a single rule, and also added, deleted, or changed at least one other rule.

a moderate number of rules (2-7) could reach an equilibrium point, where there is minimal need for new rules. Subs in this range also deleted between 1-2% of their rules, so there seems to be relatively small change in the length of the rules corpus here. This finding contradicts **H5**; it shows that the percentage of rules added generally increases with high numbers (10 or more) of initial rules. Similar to rule deletions, subs that were initially more liberal with the length of their rules corpus were also more liberal about adding rules, suggesting that overall rule churn increases in subreddits that have a high number of initial rules.

These findings were supported by our negative binomial regression models. According to the models, the number of initial rules has a significant positive relationship with both rule additions and deletions (Tables 2 and 3), confirming that subs with more heavy governance or willingness to create rules also churn rules more.

4.4 Relating Community Size to Rule Change (H6 & H7)

Hypotheses 6 and 7 expect larger subreddits to have more rule additions and deletions. Most of the subs that added at least one rule had an order of magnitude higher subscriber counts (119431 subscribers on average) compared to subs that did not add any rules (Figure 5). The subs that deleted at least one rule had similarly high subscriber counts compared to the subs that did not delete rules (Figure

Initial Rules and Rule Deletions Ratio

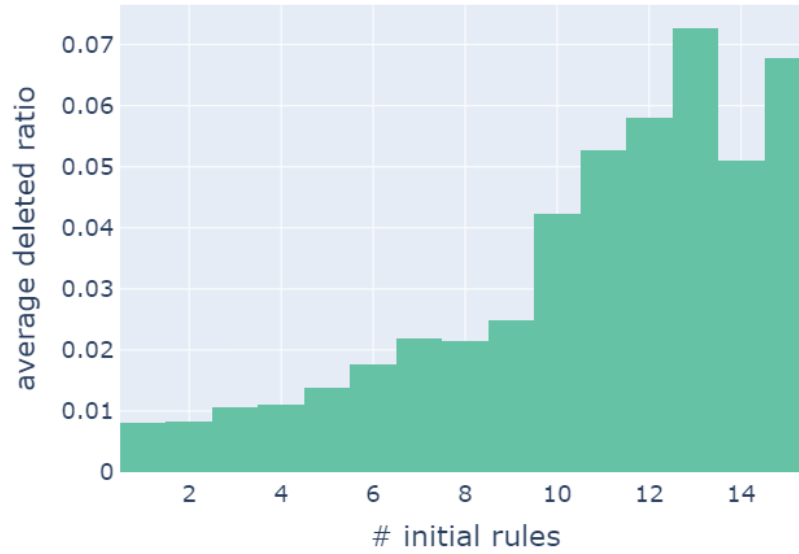


Figure 3: The ratio of rule deletions to the number of initial rules increases with the amount of initial rules.

Table 2: Rule additions increase with initial rules and subscribers.

	coef	std err	z	P> z	attr. deviance
intercept	-6.0085	0.127	-47.233	<0.001	
initial rules	0.2507	0.019	13.064	<0.001	637
age	0.0455	0.021	2.137	0.033	160
log(subscribers)	0.4855	0.018	27.558	<0.001	4407
age:log(subscribers)	-0.0077	0.002	-3.641	<0.001	
initial rules:log(subscribers)	-0.0152	0.002	-6.136	<0.001	
initial rules: age	-0.0008	0.002	-0.435	0.664	
		n: 130851	df: 6	D: 67778	R^2 : 0.08

Coefficients of the negative binomial regression model, where n is the number of observations, df is the degrees of freedom of the model, D is the deviance, and R^2 is the McFadden pseudo- R^2 . The attributed deviance column refers to the likelihood-ratio test and shows how much the deviance differs between the nested model without a given parameter and the complex model with all parameters.

6). This suggests that subreddits with larger communities update and enforce rules more, leading to more policy changes than less heavily trafficked subs. The regres-

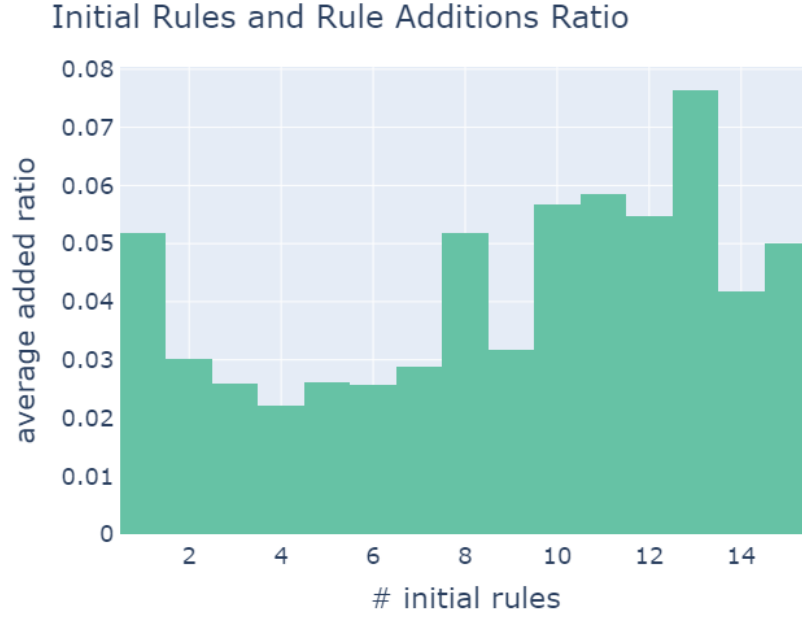


Figure 4: The ratio of rule additions to the number of initial rules initially decreases, and then increases with the amount of initial rules.

Table 3: Rule deletions increase with initial rules, age, and subscribers.

	coef	std err	z	P> z	attr. deviance
Intercept	-6.8517	0.13	-52.677	<0.001	
initial rules	0.329	0.019	17.108	<0.001	1004
age	0.0736	0.023	3.204	0.001	74
log(subscribers)	0.4141	0.018	23.238	<0.001	2366
age:log(subscribers)	-0.0119	0.002	-5.038	<0.001	
initial rules:log(subscribers)	-0.0099	0.002	-4.079	<0.001	
initial rules:age	0.0021	0.002	1.075	0.283	
n: 130851		df: 6		D: 43586	R^2 : 0.09

Coefficients of the negative binomial regression model, where n is the number of observations, df is the degrees of freedom of the model, D is the deviance, and R^2 is the McFadden pseudo- R^2 . The attributed deviance column refers to the likelihood-ratio test and shows how much the deviance differs between the nested model without a given parameter and the complex model with all parameters.

sion models support **H7** and **H8**; we can see that both rule additions and deletions increase significantly as a subreddit's size increases (Tables 2 and 3). In fact, using

the likelihood-ratio test we found that the number of subscribers is the parameter that reduces the deviance of the model most significantly for both additions and deletions.

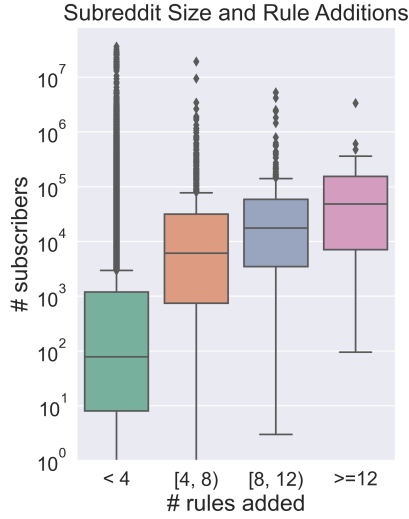


Figure 5: Subreddits that added more rules tended to be larger. The y axis is log-scaled, so the average number of subscribers increases by multiple orders of magnitude for subs that added more than four rules.

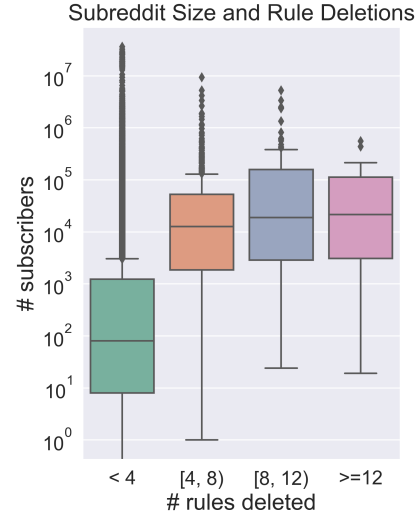


Figure 6: Subreddits that deleted more rules tended to be larger. The y axis is log-scaled, so the average number of subscribers increases by multiple orders of magnitude for subs that deleted more than four rules.

4.5 Relating Rule Age and Rule Change (H8)

We explored the relationship between rule age and its status in the second snapshot to test hypothesis 8. On average, the rules that were deleted were younger than the rules that remained unchanged between snapshots (Figure 7). This is expected; rules that had been in existence for longer periods of time before the first snapshot were more likely to have withstood the test of time and not require removal. However, we can see from Figure 7 that rules start to get deleted more often than they are left unchanged as rules get very old (over four years old); perhaps this is the time period at which rules start to become seriously outdated. **H8** posits that older rules are more likely to be deleted, because as a rule ages it is more likely to become outdated. Our logistic regression model (Table 4) shows that rules are generally less likely to be deleted as the rule age increases, whereas rules are more likely to be unchanged while the rule age increases. This supports the competing hypothesis that older rules are more likely than younger rules to withstand the test of time.

Rule Age and Rule Status

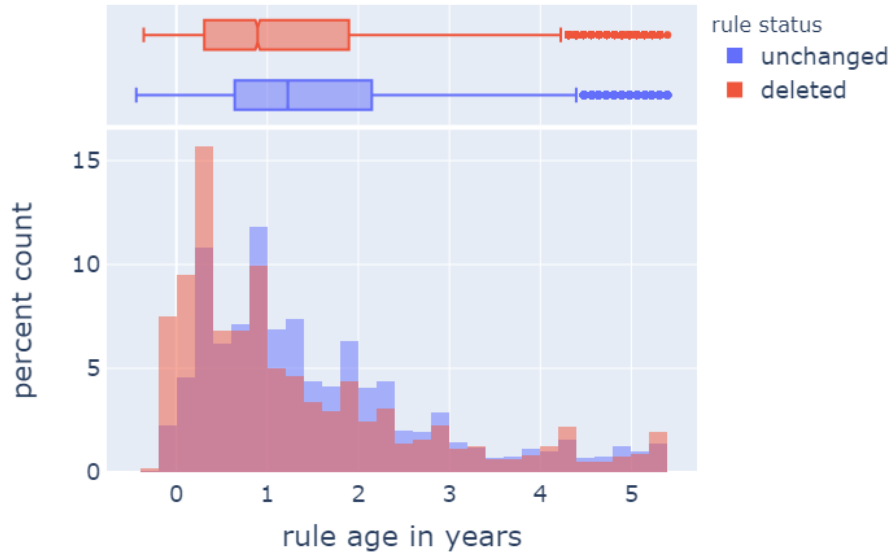


Figure 7: This stacked histogram shows that rules were deleted more often if they were less than a year old or greater than four years old. The top panel contains a whisker plot showing the distribution of rule age for rules that were unchanged (blue) and deleted (red).

Table 4: Older rules are less likely to be deleted.

	parameter	coeff	std error	z	$P > z $
unchanged	rule age	0.369	0.006	57.4	<0.001
	intercept	2.44	0.010	256	<0.001
	n: 525018		df: 1	LL: -1.0424e+05	R^2 : 0.02
deleted	rule age	-0.154	0.009	-16.9	<0.001
	intercept	-3.77	0.016	-238	<0.001
	n: 525018		df: 1	LL: -4.7605e+04	R^2 : 0.003

Coefficients of two logistic regression models, looking at the relationship between a rule's age and its status in the second snapshot, where n is the number of observations, df is the degrees of freedom of the model, LL is the log-likelihood, and R^2 is the McFadden pseudo- R^2 .

4.6 Relating Subreddit Age and Rule Change (H9 & H10)

Our last two hypotheses expect additions and deletions to increase with subreddit age. We found that the subreddits that added and deleted rules tended to be

older (Figures 8 and 9). However, in Figure 9 we can see that the average age of subreddits that delete rules increases less steeply with the number of rules deleted. The relationship between the age of the subreddit and the number of rule additions was inconclusive (Table 2); **H9** could not be validated. The relationship between age and rule deletions is small but significantly positive, suggesting that older subreddits are slightly more likely to delete rules (Table 3). This supports **H10**, suggesting that older communities are more willing to update and enforce policy.

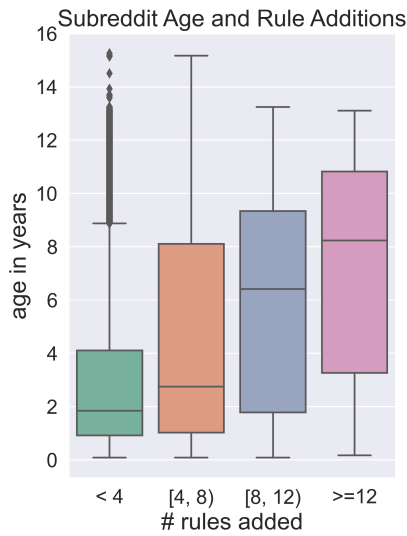


Figure 8: Rules were added more in older subs.

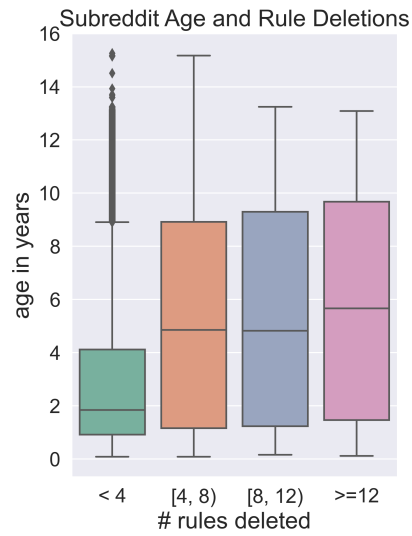


Figure 9: Rules were also deleted more in older subs.

5 Discussion

- H1 Community rules change by accretion rather than revision.** Significantly more rules were added than deleted or changed between the snapshots, supporting this hypothesis (Figure 1).
- H2 Large changes to a community's rules will be rare compared to incremental changes.** Almost twice as many communities changed multiple rules as the ones that changed a single rule, refuting this hypothesis.
- H3 Incremental changes will tend to be rule additions.** 83% of the subreddits that had incremental change added a rule, supporting this hypothesis (Figure ??).
- H4 The more initial rules the subreddit has, the greater percentage of their rules will be deleted.** Our model showed that the rule deletions increased in subreddits that had more initial rules, supporting this hypothesis (Table 3).

- H5 The more initial rules in the subreddit, the the less the percentage of their rules corpus would be added.** Our model showed that the rule additions increased in subreddits that had more initial rules, refuting this hypothesis (Table 2).
- H6 The bigger the subreddit, the more rules they will add.** Our model showed that rule additions increased with the number of subscribers that the subreddit had, supporting this hypothesis (Table 2).
- H7 The bigger the subreddit, the more rules they will delete.** Our model showed that rule deletions increased with the number of subscribers that the subreddit had, supporting this hypothesis (Table 3).
- H8 The older the rule, the more likely it is to be deleted.** Our model showed that rule deletions decreased with the number of subscribers that the subreddit had, refuting this hypothesis (Table 4).
- H9 The older the subreddit, the more rules they will add.** Our results were inconclusive for finding a relationship between the age of the subreddit and the number of rules it added (Table 2).
- H10 The older the subreddit, the more rules they will delete.** Our model showed that rule deletions increased with the age of the subreddit, supporting this hypothesis (Table 3).