# Centralisation on Decentralised Online Social Networks

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## Centralisering på decentraliserade sociala nätverk online

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## ABSTRACT

The rapid growth of centralised social media platforms such as Twitter and Facebook has raised concerns about privacy and the concentration of power held by the companies behind these services. In response, decentralised social media platforms have emerged as alternatives, forming federations of various instances without a single owner. However, these decentralised platforms have faced challenges with centralisation, as users tend to gather on larger instances. This paper examines Mastodon, one of the most popular decentralised platforms, to explore whether its onboarding flow and website design can be modified to encourage less centralisation. The study maps Mastodon's onboarding flow and identifies potential modifications to mitigate centralisation. Additionally, a new design for the official website is proposed. User tests involving five participants were conducted to evaluate the effectiveness of these changes. The results indicate that modifying the design can influence users to choose smaller servers. One effective modification is randomising the order in which servers are presented, eliminating the advantage of larger servers. Another proposed change is to improve user awareness about how feeds and interactions on Mastodon spans servers, enabling users to interact beyond their own server and removing a motivation for choosing a larger one. But the impact of this information on user behaviour remains inconclusive in the user tests. Overall, this research suggests that through design modifications, Mastodon can encourage users to select smaller servers and foster a more decentralised social media environment.

## Keywords

Social media; centralised platforms; decentralised; platforms; Mastodon; onboarding flow; user tests; randomisation; centralisation; decentralisation.

## SAMMANFATTNING

Den snabba tillväxten av centraliserade sociala medieplattformar som Twitter och Facebook har väckt oro över personlig integritet och koncentrationen av makt hos företagen bakom dessa tjänster. Som svar har decentraliserade sociala medieplattformar dykt upp, där plattformen består av en federation av olika instanser utan en enda ägare. Dessa decentraliserade plattformar har dock stött på utmaningar med centralisering eftersom användare tenderar att samlas på större instanser. Den här rapporten undersöker Mastodon, en av de mest populära decentraliserade plattformarna, för att undersöka om dess onboardingflöde och designen av deras webbplats kan modifieras för att uppmuntra mindre centralisering. Studien kartlägger Mastodons nuvarande onboardingflöde och identifierar potentiella ändringar som kan mildra centraliseringen. Dessutom föreslås en ny design för den officiella webbplatsen. Användartester med fem deltagare genomfördes för att utvärdera effektiviteten av dessa förändringar. Resultaten indikerar att den modifierade designen kan påverka användare och få dem att välja mindre servrar. En effektiv förändring är att randomisera ordningen i vilken servrar presenteras, vilket eliminerar fördelen större servrar har i hur synliga de är. En annan föreslagen förändring är att förbättra användarnas medvetenhet om att flöden och interaktioner på Mastodon sträcker sig över servrar, vilket gör det möjligt för användare att interagera utanför sin egen server och tar bort ett av motiven användare har för att välja en större server. Vilken effekt det här har på användarnas beteende när det gäller deras val av server var dock oklart i användartesterna som utfördes. Sammantaget tyder denna undersökning på att Mastodon genom designändringar potentiellt kan uppmuntra användare att välja mindre servrar och främja en mer decentraliserad miljö för sociala media.

# 1.    INTRODUCTION

Social media platforms have grown immensely in size this past decade, with networks such as Twitter, Facebook, Instagram, Youtube, and others dominating much of the media landscape. These could be considered 'centralised', in that they are owned by a single entity–such as companies like Meta and Google–who have control over the servers and possess administrative power on the platform. In recent years, there has been a growing concern about privacy issues and potential exploitation by these media giants and as a result, decentralised online social networks (DOSNs), such as Mastodon, have gained more attention as alternatives to conventional online social networks (OSNs).

These decentralised networks enable the operation of social networking services where the ownership and administrative authorities are not necessarily centralised behind one company. This is mainly achieved through open-source technologies and the platforms allowing whoever may wish so to create 'instances' on the networks. These instances can be likened to servers or sub-platforms of their own [13]. Multiple instances can then communicate to form a largely coherent network even while operating separately. Additionally, by sharing the same communication protocol, different DOSNs can work together, allowing them to comprise a massive social network sometimes referred to as the "Fediverse" [5].

These DOSNs have, at least in part, been created by non-profits in an ideologically-driven effort to 'democratise' social media. By empowering more people to create instances and take control of data ownership and moderation, DOSNs offer a wider range of options for users, without monitoring user activity to sell personal data to advertisers or using algorithms to manipulate and shape social streams [4]. However, despite the intention for platforms like Mastodon to be decentralised, there have been signs of centralisation over time. An example of this is the instance mastodon.social, officially managed by the DOSN Mastodon, which grew so large that Mastodon had to stop new account creation at one point. Various factors contribute to this centralisation, such as user-driven pressure which skews the popularity of the platform towards certain instances [13]. An example of this user-driven pressure is people's tendency to sign up for instances that are larger and more popular.

In this paper, we aim to investigate how these decentralised online social networks (DOSNs) can stay true to their purpose of serving as decentralised alternatives to conventional, centralised social media networks such as Twitter and Facebook. Specifically, this is done by examining the onboarding flow in Mastodon, which encompasses the processes through which new users are integrated into the platform, in order to identify potential changes that encourage behaviour that can aid in reversing the trend of centralisation.

# 2.    BACKGROUND

## 2.1 Terms and Definitions

### 2.1.1 Technical resources
Hardware and software required to operate the social network, such as server computers and cache sites.

### 2.1.2 Centralised management of services
A single entity, such as a corporation or individual, overseeing all aspects of a social network, including technical resources and the enforcement of rules and policies.

### 2.1.3 Source of information
The location of the content and data possessed by a social network, whether it resides in a single data centre or is distributed among multiple computers.

### 2.1.4 Technical debt
Increased complexity in software due to rapidly changing requirements and changes in scale, like how a large influx of new users can cause fast and less thought out solutions to accommodate the new population.

### 2.1.6 OSN
Online Social Network: a social network that is explicitly centralised in terms of authority, with a single provider controlling all resources and management, employing centralised management of services.

### 2.1.7 DOSN
Decentralised Online Social Network: a social network that is explicitly decentralised in both a technical manner and in terms of authority, without centralised management of services.

### 2.1.8 Instance/Server
A source of information in a DOSN, much like a server on other platforms, where users can sign up and interact with other instances. The terms "Server" and "instance" will be used interchangeably hereafter.

### 2.1.9 Federation
A network of instances that interact with one another using the same format and communication protocol.

### 2.1.10 Fediverse
A collective term for all DOSNs that utilise or allow the same communication protocol, creating a larger social network through inter-federation communication.

## 2.2 Decentralised Online Social Networks (DOSNs)

Decentralised online social networks is a concept that emerged as a response to the perceived drawbacks of centralised online social networks. These drawbacks encompass both technical and social issues. While the list of issues is extensive, we will henceforth focus on the issues that have emerged as a result of the centralised management of services on popular online social

networks (OSNs) such as Facebook, Twitter and Instagram. These issues are, among others, high technical complexity, privacy violations, censorship, disinformation and filter bubbles. Below, we elaborate on these issues.

The increasing technical complexity in OSNs can be attributed to performance-related scalability issues that arise with the rapid growth of these networks. These issues occur when the OSNs attempt to distribute content to a large user base from a single source of information [3]. Addressing these complications requires significant engineering efforts, resulting in both technical debt and added complexities to the platforms which incur high costs. The issue is exacerbated by OSNs collecting extensive amounts of metadata for advertising purposes, which adds additional complexity for data management.

The other drawbacks of OSNs are more socially oriented, yet closely tied to the high operating costs. While the technical complexities and the issues brought about by them may not directly impact users, the expenses associated with maintenance and infrastructure engineering can lead to other concerns, often in conjunction with profit incentives. These concerns include the need for a high level of trust in the service manager, privacy violations, and censorship concerns [11]. To offset the costs of maintaining a centralised management of services, OSNs monetise user data beyond what users may ideally wish to share, giving them considerable power to utilise that data as the system administrators [2]. This power also enables censorship, manifested partly through individuals being denied entry into an OSN or through content filtering. Consequences of such practices include the spread of disinformation and the creation of filter bubbles [14].

The main idea behind centralised online social networks was to address these inherent weaknesses in OSNs. While different types of DOSNs can vary significantly in appearance and purpose (similar to how OSNs like Twitter and Facebook serve two separate functions), the fundamental concept of how they operate remains similar. Instead of relying on a single source of information with centralised management of services, DOSNs are built on a distributed information management platform. This can take different forms, such as a *peer-to-peer system* or a *network of trusted servers* ("instances") [3]. It is crucial to distinguish between technical decentralisation and decentralisation of power, as both peer-to-peer systems and server networks can qualify as the former, but not the latter. Most of the problems DOSNs are intended to address are more closely related to decentralisation of power, wherein separate independent authorities administer and maintain the technical resources allocated to them [11]. In practice, this means that each instance, in the case of trusted server-based DOSNs, is independently managed

with its own administration, content policies, and technical resources. There is essentially no single provider governing the entire network, and all tasks required to operate the system, be they technical or administrative, are shared among many independent providers [3].

A social network structured in this manner can tackle many of the concerns associated with OSNs. As a result of technical decentralisation, the operational reliability of DOSNs is improved compared to OSNs because a high degree of redundancy is built into the design. If one instance experiences performance issues or goes offline, the other instances on the network remain unaffected.

Another advantage of technical decentralisation is the reduced financial cost of running a social network. In a DOSN, each independent instance is responsible for managing the maintenance cost with its own resources. Conversely, with traditional OSNs, a single entity carries the burden of the entire network. Since the required technical resources and associated costs scale non-linearly with the number of active users, having multiple smaller instances is a more cost-effective solution than having a single provider [12].

As for decentralisation of power, DOSNs inherently offer improved user privacy control, since privacy preservation is enforced at a technical level [15]. Data is stored either on peers of the user or on a storage server chosen by the user. In either case, privacy is guaranteed as the user actively decides where the information is stored and who can access it, with most DOSNs also implementing encrypted storage as well [1]. The incentive for data collection is also minimised due to reduced economic incentives resulting from the lower cost of running smaller servers independently [3].

Censorship is similarly addressed, as there is no central authority to impose restrictions on content. This does not mean that all types of content are universally available on DOSNs, however. Each instance is free to establish its own content restrictions, providing users with the freedom to choose which restrictions they wish to abide by [11].

DOSNs with the properties outlined above emerged first in the early 2010s, with various projects such as PrPI, MR. Privacy, Diaspora and Peerson [25,26]. During this time, several architecture models for DOSNs were tested, and while some projects were short-lived, others gained more longevity. This trend continued into the mid-2010s with the introduction of additional implementations and theoretical models, such as ActivityPub. ActivityPub became an internet standard in the Social Web Networking Group of the World Wide Web Consortium (W3C) in 2018 [20]. It provides a standardised approach for how DOSNs connect and interact among their

instances and has led to the development of numerous DOSNs built with this standard in mind. This allows communication not only within the instances of a single DOSN, but also between different DOSNs, forming "federations" of instances. By adopting the same communication protocol, these DOSNs have effectively become part of a larger social network commonly referred to as the Fediverse [5, 17]. Some notable examples of DOSNs built on this standard include PixelFed, Peertube, and Mastodon.

## 2.3 Mastodon

Mastodon is an open-source decentralised online social network founded in 2016 [18]. It has gained considerable interest in the current decentralised landscape and is often compared to Twitter in terms of the user experience it provides. In the wake of decreasing trust and uncertainty among Twitter users following Elon Musk's acquisition of the platform, Mastodon has been spouted as one of the alternatives that dissatisfied users can migrate to [17].

Mastodon offers microblogging functionality that provides administrators with the ability to create their own independent Mastodon instances that often focus on specific themes or areas of interest. Each instance allows users to register new accounts and create posts that can be read by their followers and other users within the instance, resembling how tweets function on Twitter. Users can also "boost" these posts, which is Mastodon's equivalent to retweeting [13]. Some popular instances include mastodon.social and mstdn.social, both of which are general instances with a similar focus, and techhub.social, which focuses on technology [19].

Instances on Mastodon can function in isolation, but they can also federate, allowing for cross-instance communication. For example, posts from mastodon.social can be displayed on techhub.social, and users registered on one instance can follow users registered on another instance. This subscription is managed by the instance on the user's behalf in a process that uses open networking protocols, which make Mastodon compatible with other microblogging platforms [13].

The structure of Mastodon's timeline is relatively simple and consists of three primary feeds: the *home*-timeline, the *local*-time, and the *federated*-timeline (as shown in Figure 1). The *home*-timeline displays posts from accounts that the user follows, the *local*-timeline shows posts created within the instance, and the *federated*-timeline contains public posts known to the user's instance, including posts from other instances [4]. Additionally, there is an *Explore*-timeline that showcases posts from different instances gaining traction at the moment on the current instance.
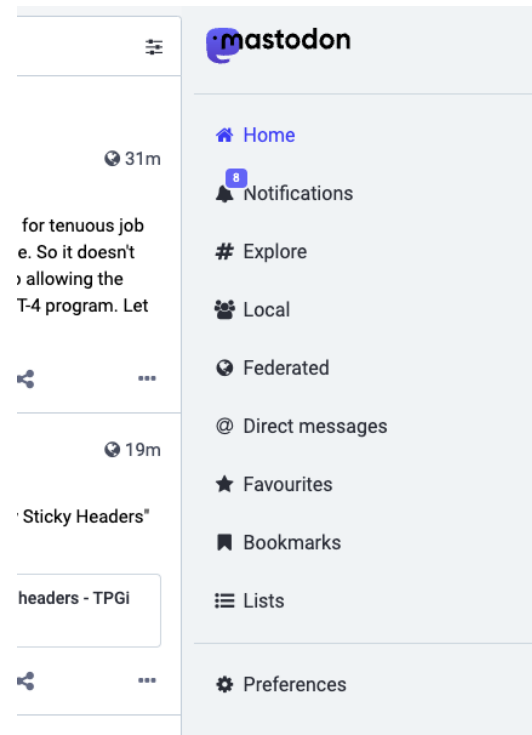


**Figure 1.** *Mastodon's different pages, with the three primary feeds "Home", "Local" and "Federated" visible.*

Mastodon's relative popularity, with 1.1 million active users compared to Pixelfed's 172,000 users, makes it a good example for examining the growth of decentralised online social networks in real-world scenarios. The trend for centralisation across specific instances is also apparent on Mastodon, where the vast majority of new users tend to join the largest instances, such as mastodon.social, which can be considered one of the platform's flagship instances. Taking this into consideration, one may question whether Mastodon can truly be regarded as a decentralised platform, or if it is simply another (semi-)-centralised service [17].

To counter the tendency for centralisation, certain instance administrators have implemented measures such as limiting the number of new users who can register on their instances, as previously mentioned with mastodon.social, but it has yet to be seen whether this will have a significant effect.

## 2.4 Pressures Driving Centralisation

When analysing centralisation on Mastodon, it is important to consider the various factors that influence the distribution of users and the natural pressures within social systems of this kind.

One prominent factor is *user-driven* pressure towards centralisation. On a macroscopic scale, users tend to drift towards larger instances. 96% of the users are

concentrated in the top 25% most populous instances, which means that a relatively small subset of administrators holds a disproportionate amount of power within the decentralised network. However, it is worth noting that this effect is partially counteracted by the fact that users on smaller instances tend to be more active compared to those on larger instances [13,4].

Another pressure for centralisation is *infrastructure-driven* pressure, which is driven by the hosting structure of instances. Simplicity and low costs often lead to instances being hosted within the same hosting providers, which is another type of centralisation. Despite its advantages, it carries risks with redundancy as discussed before. If one of these hosting providers experiences technical failures, a significant number of instances may be affected as a result [13].

## 2.5 Research Question

While infrastructure-driven pressure for centralisation is important, this study specifically looks at user-driven pressure towards centralisation, within which we investigate the onboarding flow of Mastodon that is centred on their joinmastodon.org website. In doing so we ask:

*How can joinmastodon.org's design be modified to decrease centralisation on the Mastodon platform by encouraging users to choose smaller servers for account registration?*

Our hypothesis is that carefully applied modifications and additions to the joinmastodon.org website will result in users selecting a more varied choice of servers.

## 3.     METHOD

To determine what changes could be made to Mastodon's onboarding flow in order to encourage a more balanced distribution of users across the various instances, we did three things. Firstly, we conducted an analysis of joinmastodon.org's current onboarding flow to identify potential weaknesses in relation to maintaining a decentralised service. Based on these findings, we proceeded to redesign the onboarding flow with the aim of encouraging users to select instances other than the most popular ones. Lastly, we conducted user tests to evaluate whether the redesign effectively influenced users to sign up for instances in a less centralised manner.

## 3.1 Mapping of Mastodon's Onboarding Flow

We performed the analysis of Mastodon's onboarding flow by taking into consideration both marketing and user experience aspects, with a particular emphasis on how it relates to Mastodon's established objective of establishing a decentralised platform. Our evaluation involved assessing the design and content of the

onboarding flow against onboarding best practices outlined in [21]. Throughout the analysis, we discussed and documented any shortcomings or areas of improvement within this context.

## 3.2 Redesign of Mastodon's Onboarding Flow

Building upon the analysis of Mastodon's existing onboarding flow, we employed sketches and wireframing techniques to develop a redesigned version that addressed the identified issues. This iterative process involved multiple rounds of sketching to accommodate new ideas and incorporate observations from the analysis.

To implement the redesigned flow, we utilised the source code of Mastodon's current website. We made the necessary modifications according to the wireframes we had created and deployed the redesigned version on a server using a temporary domain name so that it could be used in the user tests. The source code was obtained from Mastodon's open source repository available at https://github.com/mastodon/joinmastodon, which is licensed under GNU Affero General Public License v3.0 [23].

## 3.3 Recruitment of Participants

Previous research suggests that when performing user tests, after around 5 users per user group, the insights gained from additional participants regarding usability problems and features tend to yield diminishing returns [9]. This made 5 participants a reasonable figure to aim for with our tests. To minimise the impact of external factors such as previous experience with Mastodon and any pre-existing biases or inclinations people might hold for creating accounts on certain servers, participants for our user tests were recruited based on the following inclusion criteria:

1.  They should have no previous experience with Mastodon's onboarding process. It is preferable that they have not heard of the platform, or at the very least are unfamiliar with its structure and its servers.
2.  They should have some prior experience with other social media such as Twitter or Facebook, to ensure that general ignorance about what social networks are and how they work will not affect the results.
3.  When asked, they should have displayed some basic interest in creating a Mastodon account, in order to properly represent the users that might actively seek out the platform to create accounts themselves.

To recruit participants, we reached out to family and friends both digitally and in person, asking them if they

wished to participate. By following these criteria, we successfully recruited and obtained the desired number of 5 participants. All were within the age range of 20-30 years.

## 3.4 User Tests

The user tests were conducted using a qualitative approach, following established practices common in UX design [8]. During the tests, one of us acted as a facilitator who was responsible for observing the participants, asking questions, providing instructions, and taking comprehensive notes of comments made by the participants and the way in which they interacted with the site. The tests were carried out either in-person at one of our apartments or digitally depending on the participants' circumstances. For remote tests, we used the video conferencing tool Zoom and its screen-sharing functionality. All participants were given access to our redesigned version of joinmastodon.org through their preferred web browser, either on their own computers or on our desktop computers. Prior to the tasks, participants signed consent forms confirming their willingness to take part.

The tests consisted of six scenarios, each with the accompanying task of finding a server the participant wanted to sign up on. For each scenario, the participant started at the first page and was informed what the context of that particular scenario was before being asked to solve the given task within that context. Throughout the task completion process, participants were encouraged to verbalise their thoughts and actions. The time needed to complete each task varied from one minute to five minutes, depending on the participant. The scenarios were performed in the same order for all participants, and the entire process took around 20-30 minutes for each participant.

The six scenarios and tasks were as follows:

1. "You have just heard about this new social media platform called Mastodon, and you know that there are already some noted personalities that you have an interest and might like to follow who are present on the platform. You are interested in signing up on Mastodon as well."

   **Task:** *Find a server you would like to sign up on.*

2. "You have just heard about Mastodon, though you don't know if any particular people that you want to follow are on it. You do however have an interest in joining a Swedish language community."

   **Task:** *Find a server you would like to sign up on.*

3. "You have just heard about Mastodon, and you have an interest in joining a community that is focused on technology."

   **Task:** *Find a server you would like to sign up on.*

4. "You have just heard about Mastodon and you have an interest in academia."

   **Task:** *Find a server you would like to sign up on.*

5. "You are already familiar with Mastodon and how it works now, although you don't have an account on the platform yet. There are several areas that you have an interest in, including technology, Sweden, and the climate, but you don't know which to prioritise."

   **Task:** *Find a server you would like to sign up on.*

6. "You are already familiar with Mastodon and how it works now, although you don't have an account yet. You are interested in joining one of the largest servers."

   **Task:** *Find a server you would like to sign up on.*

The first task aimed to introduce participants to Mastodon and observe how a completely new user would navigate and process information on joinmastodon.org. The subsequent three tasks were designed to assess how users interacted with the site to find a specific type of

server, using different areas of interest to ensure diverse data. The fifth task focused on understanding how users with multiple specific interests consider the cross-instance communication between Mastodon's servers when making their choice. The sixth task aimed to observe the participants' behaviour when intentionally seeking to join a large server and to evaluate the ease of this process.

After each task, the participants were asked to explain the reasoning behind their choice of server. Their responses and how they carried out the tasks were recorded for later analysis. At the end of the tests, participants were given the opportunity to provide any additional comments that might not have been addressed during the tasks.

The participants were not provided knowledge about what Mastodon is or how it works before the user tests, beyond that it is a social network that has been growing in size recently and is similar to Twitter. They were also not informed of the purpose of the user tests, but were simply told that the tests focused on improving the UX design of the page. The reason for this was to provide an onboarding experience from the perspective of someone who is not aware of Mastodon's goals regarding decentralisation.

The data from the user tests was analysed by initially collecting our notes and transcript excerpts for each participant's user test. These observations were then categorised based on the corresponding part of the redesigned onboarding flow, such as the call to action, information screens, the server list, as well as which scenario they were from. This allowed us to have a comprehensive overview of how the results looked and how they were related to each other and the different parts of the onboarding flow. The data was then analysed in a qualitative manner by comparing it relation to our research question and identifying what parts of the results were relevant and if any of our design changes might have caused them. Additionally, we counted and categorised the participants' motivations for each server choice and charted the sizes of those servers in order to determine if there were any tendencies towards choosing larger servers, and if so, the underlying reasons behind those choices.

## 4.    RESULTS

In the following section, the results will be presented, beginning with the analysis of Mastodon's current onboarding flow, followed by the proposed redesign and the results obtained from the user tests of the redesigned site

## 4.1 Analysis of Current Onboarding Flow

Mastodon's current onboarding flow can be described in three separate steps:

1. **Discovery** (see Figure 2 and 3)
   This is where prospective users learn of and discover Mastodon. This can occur through various means, such as word of mouth or internet searches. It is important to note that this step is challenging to directly influence or control.
2. **Call to action** (see Figure 4 and 5)
   In this step, Mastodon aims to capture users' interest by providing information about the platform and how it functions in order to encourage them to sign up.
3. **Choice of server** (see Figure 6)
   This is where the users are presented with a list of Mastodon servers to choose one they want to create their account on.
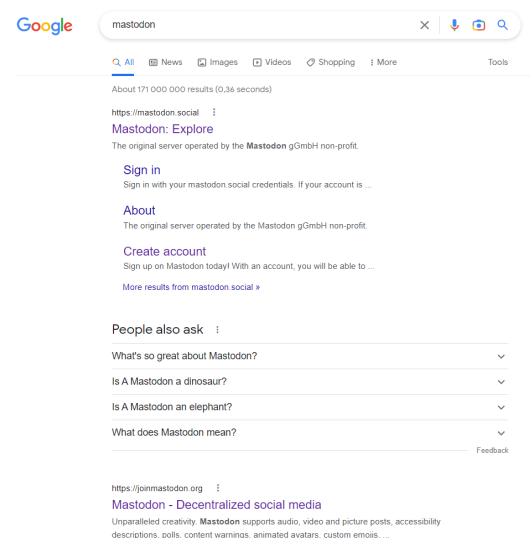


*Figure 2. Step 1: A Google search of "mastodon". What is most notable here is that joimastodon.org is below mastodon.social in the search results, indicating that a specific Mastodon server is more visible than the official onboarding website of Mastodon.*
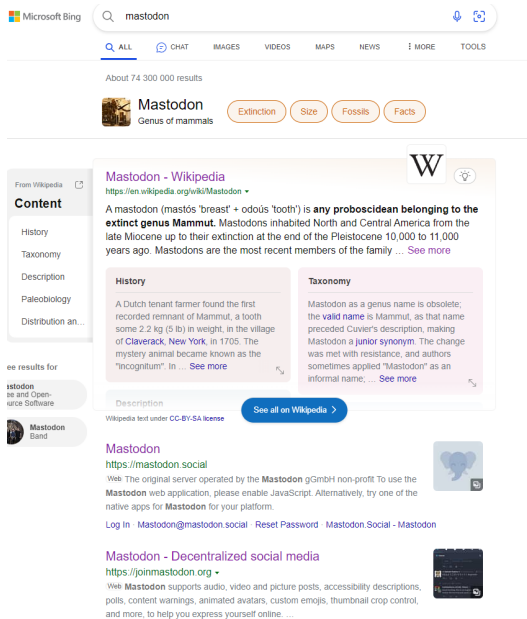
Figure 3. Step 1 (continuation): A Bing search of "mastodon". Similar results to Google, but here both mastodon.social and joinmastodon.org are placed below the wikipedia article on mastodons, the genus of mammals the platform was named after. This would be difficult to change without renaming the platform.
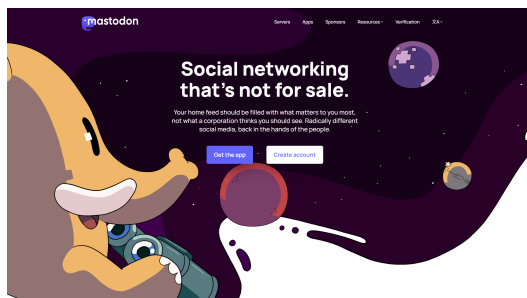


Figure 4. Step 2: A screenshot of what the user sees when they first visit joinmastodon.org. The design is casual, featuring simple art that evokes thoughts of space and exploration. It directs the user's attention to the centre of the screen, where they try to "sell" Mastodon's vision.
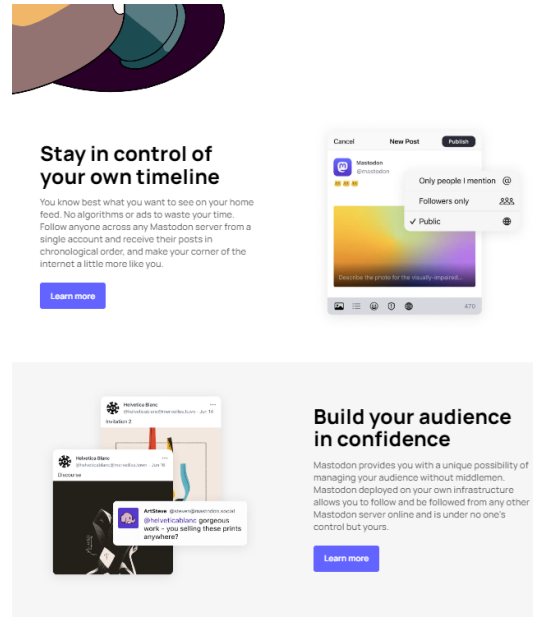


Figure 5. Step 2 (continuation): A screenshot of what the user sees if they scroll down further on the landing page. This section primarily includes brief descriptions of the various uses of Mastodon. The fact that there is more to the page than shown in the previous figure is easy to miss, however.
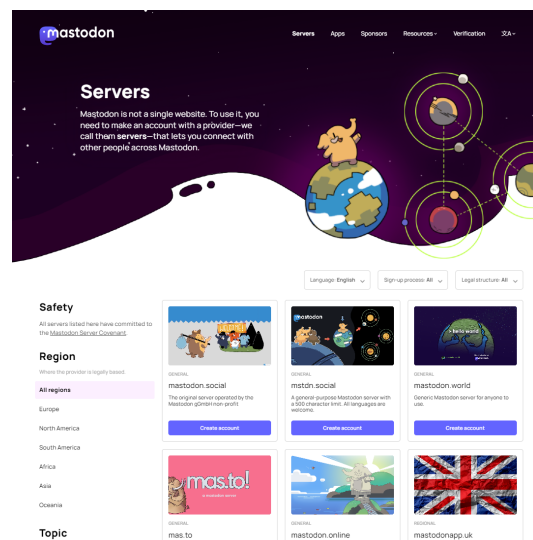


Figure 6. Step 3. An overview of the server page that is accessed by clicking on "Create account" or "Servers" on the previous page. This overview maintains the same thematic as the landing page, with the servers being the central focus. They can be displayed by Region and Topic, and further filtered by Language, Sign-up Process, and Legal Structure. There is no apparent way of searching for a particular server or sorting them by size.

In any onboarding flow, the Discovery step could be considered the most important simply because users cannot take part of your service if they do not know of its existence. However, in Mastodon's case, the decentralised nature of the platform poses a challenge. The official site, joinmastodon.org, runs the risk of being overshadowed by larger servers like mastodon.social, and searches related to mastodons (the mammal) can also affect the visibility of the platform, as shown in Figures 2 & 3. This is not optimal if the goal is to garner more users for a social media in an online landscape already bustling with similar services. However, since this can be difficult to change and does not directly affect how existing users interact with the later steps of the onboarding process, which are the steps that can most easily be influenced through UX design and choices on Mastodon's end, the Discovery step is not where our focus lies.

The Call to Action step, where users are brought to the landing page (as shown in Figures 4 & 5), is designed to catch their attention and encourage them to continue with the onboarding process. What is perhaps of most interest here is that while the page does try to inform the user about what Mastodon is, it does not *explicitly* do so. Instead, it uses phrases such as *"Social networking that's not for sale"* and *"Radically different social media, back in the hands of the people."*. It is not uncommon in marketing for companies to utilise succinct and memorable phrases like these to try and encapsulate their brand's identity and convey key messages to their target audiences, and here Mastodon is attempting to do something similar. This, coupled with the general design evoking a sense of exploration and pioneering and the two attention-grabbing "Create account" & "Get the app" buttons at the center of the page, serves the purpose of catching the users' attention and encouraging them to continue forward in the onboarding process. The more detailed descriptions on how Mastodon works and what it is used for, as shown in Figure 5, carries less importance in this design, as the users have to scroll down in order to find them. It should also be noted that these descriptions appear to rely on the user being at least mildly acquainted with what type of platform Mastodon is in order to be fully understood, and explanations of what the decentralised and open-source nature of Mastodon actually signifies are hidden away at the bottom of the page.

When considering the objective of discouraging centralisation across Mastodon servers, the current approach of capturing users' attention while providing information about the platform at the same time could be problematic, in the sense that the amount of necessary information might overwhelm users and reduce their interest. We argue that ensuring that prospective users are aware of how Mastodon works and how they can easily

interact with other servers is an important factor in encouraging users to sign up not only on the larger servers. However, the current design of the landing page makes it easy for users to overlook this information, leading to potential conflicts. The call to action prompts users to proceed immediately to the next step, causing unnecessary confusion for those of the users who do so and miss this information, subsequently potentially failing to fully grasp Mastodon's concept. The confusion arises because users are thrown into the server list without any context, leaving them without guidance on which server to select. To enhance clarity regarding server selection, it could be better to separate the step that aims to engage users from the step that provides instructions [16].

The third step of joinmastodon.org's onboarding process is where the users make an actual decision regarding how they want to interact with the platform by choosing a server. All the servers listed are officially endorsed by Mastodon gGmbH and meet the requirements outlined in the Mastodon Server Covenant [24] (which can be reviewed on the page) in addition to having submitted a direct request to the site. The current number of servers on the page only amount to 207 out of the thousands that exist [5]. Notably, some of the largest Mastodon instances, such as mastodon.social and mstdn.social, are listed at the very top of this page. Upon reviewing the source code for the page, it appears the reason for this is that the servers are ordered by a metric called "last_week_users" (shown in Figure 7). Presumably, this metric refers to the number of active users on each server or how many referrals it received from the page during the previous week.

```jsx
<div className="grid gap-gutter sm:grid-cols-2 xl:grid-cols-3">
  {servers.isLoading
    ? Array(8)
        .fill(null)
        .map((_el, i) => <ServerCard key={i} />)
    : servers.data
        .sort((a, b) => {
          if (a.approval_required === b.approval_required) {
            return b.last_week_users - a.last_week_users
          } else if (a.approval_required) {
            return 1
          } else if (b.approval_required) {
            return -1
          } else {
            return b.last_week_users - a.last_week_users
          }
        })
        .map((server) => (
          <ServerCard key={server.domain} server={server} />
        ))}
</div>
```

**Figure 7.** *joinmastodon.org's source code, showing the server sorting logic. It uses the variable last_week_users as the primary sorting method*

Once users find a server they wish to join, they can click the link to that server and be sent to its sign-up page.

This marks the end of Mastodon's own onboarding process, as users are then handed over to their chosen servers.

In summary, in examining this onboarding flow from the perspective of Mastodon's established goal of creating a decentralised platform, there seems to be a lack of significant emphasis on encouraging decentralisation in the design. By listing servers in descending order based on last week's users, popular servers are positioned at the top of the lists, making them more visible and likely to be chosen by new users, thus perpetuating their popularity. Additionally, with information about what Mastodon is as a service and how it works being placed in less visible locations and lacking detail, this onboarding flow risks neglecting to inform the users about the inherent qualities the platform has that could discourage centralisation

## 4.2 Redesigned onboarding

Since we judged that informing the user of how Mastodon works can play an important part in discouraging further centralisation, much of the focus in the redesign of the joinmastodon.org's layout was placed on achieving this goal. Using terminology from [21], we wanted users to experience what is referred to as an "aha"-moment without much friction. This "aha"-moment can be considered the point in the onboarding process after one has caught the users' attention where they suddenly fully understand what a product is about and why they should choose to use it over other alternatives. Typically with software, this "aha"-moment occurs late in the onboarding process, leading to significant drop-off rates in the sign-ups and active users [21]. However, creating this moment earlier can be challenging.. A prominent issue that designers have to account for is the *Paradox of the Active User*, a concept coined by John M. Carrol and Mary Beth Rosson [10], which highlights that users often avoid reading manuals and prefer to dive straight into using the software, despite potential long-term benefits reading the manual is likely to have. In the context of a website, this means a long tutorial would likely be skipped or create friction that deters users from signing up. Striking a balance is crucial.

With this and the insights gained from analysing Mastodon's current onboarding flow in mind, we have developed wireframes for a redesigned onboarding flow. The aim of this redesign is to reduce centralisation by encouraging users to consider servers other than the largest one during sign-up. This redesigned flow consists of the three following views:

1. Landing page: This page serves as the call to action (see Figure 2).
2. "Getting started" page: This page aims to provide users with any necessary information with as little friction as possible (see Figures 7 and 8).
3. Server page: This page displays a selection of available servers (see Figure 9).

These views are similar to the previously described steps in Mastodon's current onboarding flow. However, the Discovery step has been excluded since it is unaffected by the redesign, and we have divided the previous Call To Action step into two separate views. The wireframes for this redesign are shown in Figures 8-11
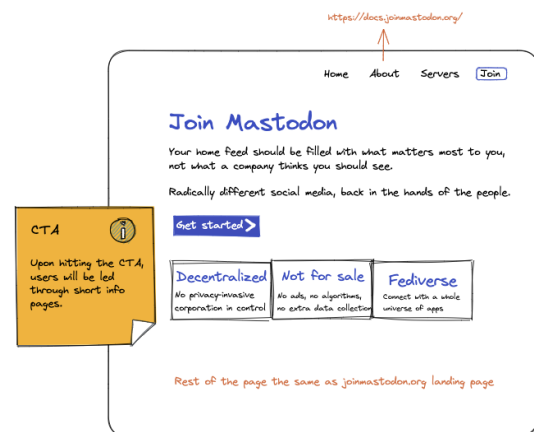


*Figure 8. View 1. Wireframe of the new landing page. The main purpose was to generate user engagement and capture interest, so emphasis was placed on representing Mastodon in a short and concise way. The "Get the app" button was removed to prioritise the "Create account" button that was relevant for our purposes. Three information cards were added as well, highlighting the platform's benefits based in comparison to mainstream OSNs. Navigation links, such as the "About" link at the top, were updated to cater to users seeking further information or direct access to the Servers page.*
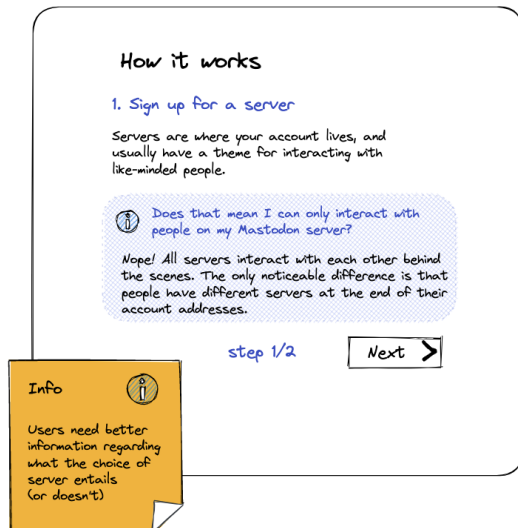
**Figure 9.** *View 2. The first of two tutorial screens. This screen explains the process of signing up for a server and emphasises that different servers can still interact with each other.*
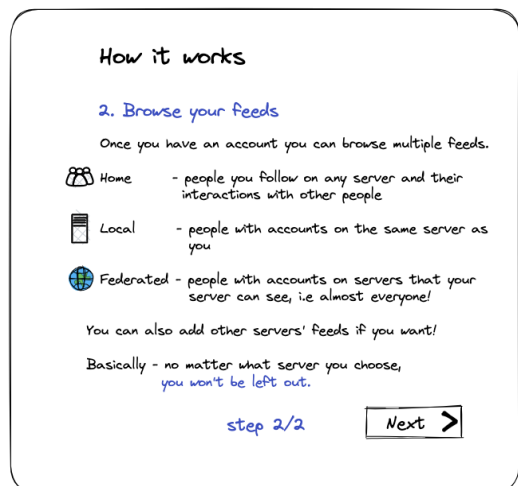


**Figure 10.** *View 2 (continuation) The second of two tutorial screens. This screen focuses on explaining how users interact with Mastodon after creating an account, including an explanation of the different feeds.*
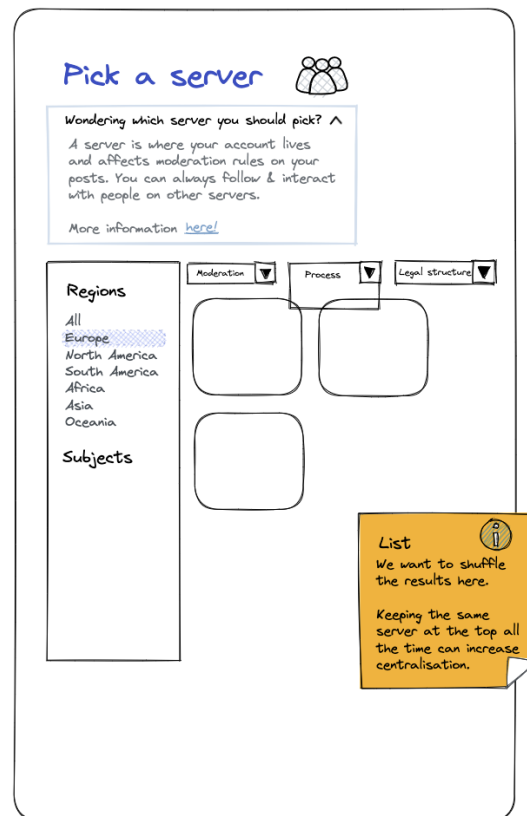


**Figure 11.** *View 3. The server selection page. We added a collapsible information box to provide a brief explanation of what a server is in case users skipped the tutorial. This is an example of contextual help, which focuses on providing help at the right moments and is a design pattern that has been shown to be more effective than enforced onboarding tutorials [7]. In addition to this, the server list itself will be shuffled in some way to avoid certain servers always being near the top.*

The landing page (Figure 8) serves as the first point of contact between the website and the user, offering an opportunity to convey both the message behind Mastodon and the website's purpose. The existing landing page already accomplished this to a certain extent, although it also attempted to provide more detailed information about Mastodon at the same time. Our changes aimed to draw more attention to the Call To Action.

The following view, the "getting started" page (Figure 9 and 10), consists of a short tutorial divided into two separate views.

The first briefly explains how servers work on Mastodon, while also trying not to overwhelm the user with too much information. We chose not to use a long page that requires scrolling to read through all the information, as that is often not preferred. However, there are trade-offs

with this decision. Firstly, having additional tutorial steps means users have more actions to take, which may lead to a drop in sign-ups. However, the degree to which this can supposedly cause drops has been shown to be greatly exaggerated. For instance, the common UX design "3-click-rule" stating that users are likely to become frustrated and leave if they cannot find what they are looking for within three clicks is unfounded [6]. Secondly, the informative effect of the tutorial may be limited if users perceive it as nothing more than an annoyance and skip through it. To mitigate these drawbacks, we implemented several measures in our redesign:

- We made all information as clear and concise as we could, accompanied by engaging graphics.
- We kept users aware of the remaining tutorial steps to discourage skipping if they feared it might be too long.
- We provided additional means of informing users aside from the tutorial, taking into account those who usually skip tutorials. For example, the "About" link on the landing page in Figure 8 directs users to Mastodon's existing documentation page, which explains in-depth how Mastodon works and how to use it. This link was accessible on all pages.

The last view, the server page (see Figure 11), underwent minimal changes in overall design. However, more focus was placed on familiarising users with how the servers worked and the more popular servers were given less visibility by shuffling the sorting order of the servers.

To summarise, we designed a total of three new pages: the landing page with a call to action, the "getting started" page with a tutorial, and the server page where the users make their final choice. The landing page retained its original purpose but was redesigned to focus on generating interest and engagement, while the tutorial and the contextual help on the server page aimed to provide more information about Mastodon. Additionally, we introduced randomisation in the order of the servers to offer smaller servers a better chance of being chosen by users.

Figures 12-15 show what the onboarding flow looked like after we had translated the wireframes with the redesigned onboarding flow onto Mastondon's site.
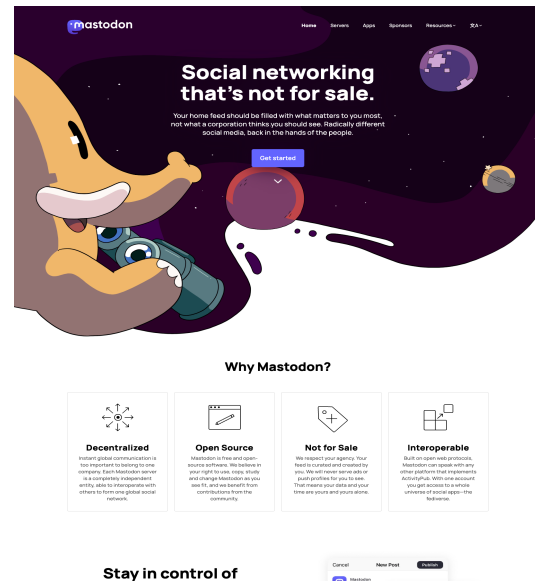


**Figure 12.** *View 1. The landing page. The art and overall design from the original site was kept to maintain the same theme. The information cards present in Figure 8 were adjusted to fit neatly at the bottom of the page without drawing too much attention. We reused assets that were already present in other locations on the original site.*
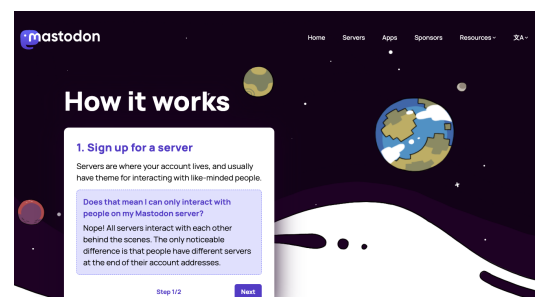


**Figure 13.** *View 2. The first step of the "getting started" tutorial. Used simple text to explain how to sign up for a server. A background that fits with the rest of the site was added.*
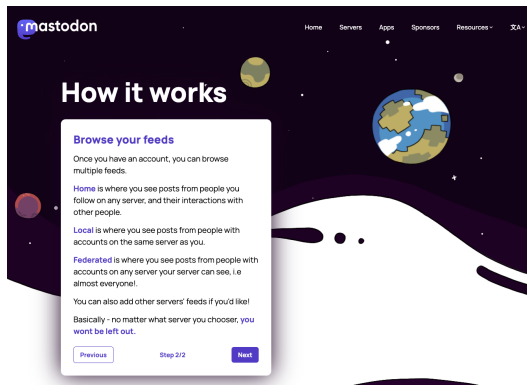
**Figure 14.** *View 2 (continuation). The second step of the tutorial. Informed the users about Mastodon's various feeds.*
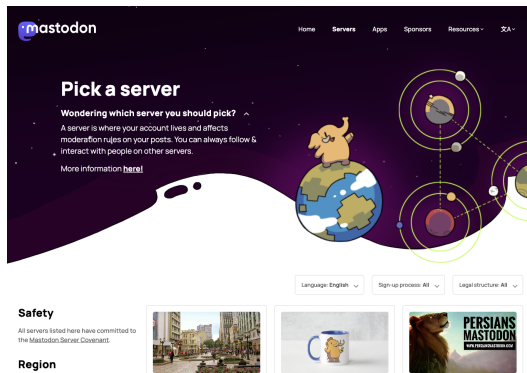


**Figure 15.** *View 3. The finished server page. Visually, it was almost the same as before, with the addition of an information dropdown titled "Wondering which server you should pick?".*

## 4.3 User Test Results

Below, we describe observations from the user tests in relation to how our redesigned onboarding flow might affect the users' choice of server and encourage them to choose smaller servers when signing up.

### 4.3.1 View 1. The landing page

The revised landing page was intended to quickly capture users' attention before leading them towards the tutorial on the "getting started" page. Upon first being introduced to the landing page in the first user scenario, participants exhibited the following behaviours:

- Three participants clicked the "Get started" button and proceeded to the tutorial after skimming through the text on the landing page.
- The remaining two participants directly accessed the server page through the "Servers" navigation button in the top right corner (see Figure 12) and missed the tutorial.

- In subsequent scenarios, the three participants who initially clicked "Get started" either repeated the same behaviour as the first time or immediately went to the server page through the "Servers" button.

### 4.3.2 View 2. The "getting started" page

The addition of the "getting started" page aimed to provide users with a quick and easy understanding of how Mastodon works and ensure they were aware of the platform's cross-server functionality for following other servers' feeds. The following behaviours were exhibited by the participants on this page:

- Four out of five participants found and read through the tutorial at some point.
- Two of those participants thoroughly read through the tutorial, while the other two only skimmed through it
- Notably, only one participant (one of the ones who read through the tutorial thoroughly) commented verbally that the choice of server might not be crucial since they could still view feeds from other servers if desired.

### 4.3.3 View 3. The server page

Two main changes were made to this page: the inclusion of a collapsible window titled "Wondering which served you should pick" and the randomisation of the server order (see Figure 11). The collapsible window appeared to have no noticeable effect, with none of the participants interacting with it. Other than that, the following observations were made for this page:

- In user scenarios two to four, where participants were asked to find servers that aligned with a given interest, some of the participants showed slight uncertainty regarding what might fall in under a specific interest, but they had no difficulties in finding servers that fit the given scenarios.
- In user scenario five, where participants were prompted to choose a server with more than one specific area of interest in mind, none of the participants appeared to consider the option of selecting a server that covered one interest and then following the relevant feeds from other servers. Even participants who thoroughly read through the tutorial and understood this aspect of Mastodon seemed to overlook it.
- In scenario six, where users were asked to choose one of the largest servers, all participants faced difficulty as the page lacked a search or filtering function for server size, and the server order was randomised. They remarked upon this, noting it made things harder than they wanted. Three out of the five

participants assumed at some point that the servers were ordered by size, popularity, or some similar metric, but two later realised it was randomised in some way. Four participants attempted to guess the largest servers by reading server descriptions and thumbnails while looking for what they thought could be popular. The remaining participant simply chose the server at the top of the page. Two participants managed to select servers that were still among the top ten largest Mastodon servers, including the largest server, mastodon.social.

When the participants were asked why they chose a particular server, the most frequent response was that they did so based on their personal interests or because it appeared to meet the requirements of the user scenario. Figure 16 provides an overview of the distribution of these motivations. In terms of server sizes, there was no clear trend indicating a preference for choosing larger servers, except in user scenario six. Figure 17 depicts the distribution of server sizes for the chosen servers.
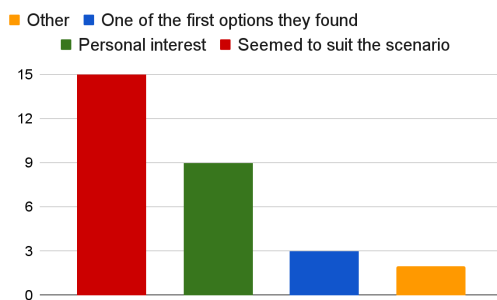


**Figure 16.** *Distribution of participants' motivations for choosing servers across all user scenarios. There were 30 in total. The "Other" category includes motivations unrelated to the topic at hand.*
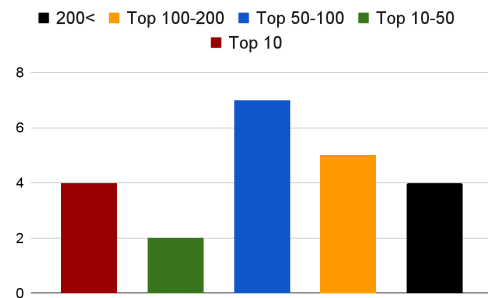


**Figure 17.** *Distribution of servers chosen by participants based on the total number of users on them according to current statistics [22]. For context, the largest server on Mastodon has 1.1 million users, the 10th largest has 73,000, and the 100th largest has 4,000. Some servers had unknown user numbers and were not taken into consideration in this graph.*

## 5.    DISCUSSION

The research question we aimed to address was as follows:

*How can joinmastodon.org's design be modified to decrease centralisation on the Mastodon platform by encouraging users to choose smaller servers for account registration?*

Among the changes made to the current Mastodon site for the user tests, we predicted the following two factors were most probable to influence how likely users were to pick larger servers:

- The user's awareness of how Mastodon as a platform worked and the ability to follow feeds of users on other servers.
- The ordering of servers on the server list page, with those higher up more likely to be chosen.

While some of the participants grasped that cross-server interactions were possible on Mastodon, their server choices and the motivation behind them did not clearly reflect this. As a result, the user tests yielded inconclusive results regarding the importance of factor in encouraging less centralisation across servers. However, the user tests still revealed varied server selections, which we attribute primarily to the randomised ordering of the servers.

The inconclusiveness regarding user awareness of how Mastodon works in regards to decentralisation, as evident from participants' lack of consideration for it in scenario six, strongly indicates that the redesigned onboarding process did not adequately inform users about this aspect. The participants who fully read the tutorial expressed comprehension of its content, but their understanding

was either absent or vague when it came to reasoning about server choices. In other words, they may have possessed the knowledge, but failed to connect it with the implications of choosing a server, which was somewhat unexpected. The user scenarios' wording may have played a role here, as the interests stated in the scenarios might have driven them to search for those interests in the server list without deeper reflection. In essence, the question might have been too easily interpreted as "find a server with these attributes." This approach may seem unnatural, as a person discovering Mastodon in reality would be unlikely to ask themselves such a question. Improving the wording of the scenario and visualisations may potentially address this issue.

The randomised ordering of servers appeared to function as intended, however, with the results showing a diverse selection of sized servers and a general lack of larger servers. In scenario 6, where participants were tasked with finding the largest server, only two managed to select servers that were in the top ten in user count. This outcome was expected, as it is challenging to identify the largest server without a provided metric to judge by, and it is similarly difficult to select the same servers as other participants due to the randomisation being unique to each individual.Was was interesting, however, was the comments left by participants when expressing frustration with this stage.

One of the issues raised was the reordering of the server list on each page visit, which made it challenging to relocate previously discovered servers. For instance, one participant commented, "Now I'm getting different results, it seems the order has changed." This is an implementation detail that can easily be addressed to reduce user irritation. While this is primarily a usability concern unrelated to decentralisation, it is worth noting that resolving it does not imply necessarily removing the randomisation. One possible solution is to randomise the order on a per-user basis rather than on a per-page-load basis. However, the fact that three out of five participants assumed that the servers were ordered by size or popularity shows that randomising the order could be misleading. That means this approach might still promote more decentralisation, but could involve unintended deception.

There were several requests made for a search function as well. One participant remarked, "There does not seem to be a search function from what I can see. You would want to have that to search for climate," referring to scenario five. Whether the inclusion of a search function conflicts with the goal of decentralisation is debatable and most likely depends largely on its implementation. One could argue that a search function's primary purpose would be to find a specific topic or region, or a combination of both. In such a case, a search function would not pose a threat to decentralisation since server

size, for example, would not be a searchable metric, and any results from the search term could be randomised.

## 5.2 Implications
The results highlight a problem that raises an important question for Mastodon to consider: is Mastodon too complex to effectively teach en masse? It is no secret that social media platforms, whether decentralised or not, are complicated, but that complexity is often irrelevant to the end user as it lies in the technology used. In the case of Mastodon, it may be crucial for users to understand the implications of their choices in order to combat centralisation, and our results indicate that even a two-step information screen–which is more than what most social media platforms offer–may not be sufficient. Adding more would likely lead to an increased skip-rate of the information screens, which was already relatively high at 40% in our user tests.

Questions like these are important for Mastodon and other DOSNs to address if their goal is to remain decentralised. Gaining insights into the factors that influence decentralisation in the onboarding process and testing potential improvements can help Mastodon and similar platforms make better-informed decisions.

## 5.3 Limitations
Since the user tests were conducted on a limited subset and small number of potential users, the extent to which the results can be extrapolated and applied to other user groups and how they would interact with the adjusted onboarding flow is limited. Additionally, the tests solely focused on discouraging further centralisation and did not take into account what other consequences the proposed redesign might have.

Similarly, our testing did not address the question of whether decentralisation is an ideal goal or not; we only acknowledged that Mastodon's stated interests claim as much. However, this question is closely connected to our results, as it is possible that no amount of changes to the onboarding experience can achieve the desired outcomes. In such a scenario, Mastodon may need to reassess its goals and aspirations or explore alternative approaches to achieve them.

Another aspect for Mastodon to consider, which was not examined extensively in this user study, is the Discovery step of the onboarding flow. In Mastodon's case, it may be relevant to review this stage, considering that Mastodon servers are visible to search engines. If a few large Mastodon servers gain significant popularity and rank higher than joinmastodon.org, it could contribute to centralisation and make a server choice less apparent to users.

Finally, it is important to note a limitation of joinmastodon.org that was not accounted for in this user study: the selection of servers presented on the server list page, which must adhere to the Mastodon Server Covenant. This restriction significantly limits the available selection compared to the total number of servers. Our participants noticed this limitation when filtering and commented on it. While it is understandable to have some measure of quality control for officially suggested servers, this limited selection could potentially lead to user frustration and increased centralisation due to the lack of choice. It could also lead to prospective users going to a third party to find what servers are available to them, ensuring that joinmastodon.org has even less power to ensure the decentralisation of the platform.

## 5.4 Recommendations for Future Research

In this user study we found that informing users about the workings of Mastodon was the most challenging aspect of combating centralisation, but it is important to recognise that there are still many unanswered questions to explore. If conducting such research with further user tests, we recommend carefully reviewing the questions posed to participants, as they can influence the results. We encountered difficulties in interpreting some results due to speculation about the impact a question's wording might have. Additionally, we suggest larger sample sizes to obtain results with higher confidence and combining the qualitative nature of our study with more quantitative data.

## 6.  Conclusion

The objective of this user study was to identify ways that the current trend of centralisation over larger instances/servers that Mastodon has experienced might be mitigated by modifying the design of joinmastodon.org. Based on the results of our user tests, it is possible to influence users' server choices such that they are more likely to sign up for smaller servers. Modifying the order in which the servers are presented, so that larger servers do not have a clear advantage over smaller ones, proved an effective method, as supported by the results of our tests. However, our findings were more inconclusive on whether informing the users about the decentralised nature of Mastodon, and its function of cross-server interactions, might engender a similar effect. This may be attributed to the somewhat artificial manner in which the user scenarios were presented. Nonetheless, our results indicate that striking a balance between providing information and ensuring user retention in the onboarding flow may be challenging for Mastodon, but that our findings can possibly be a first step in addressing this issue.

## References

[1]Andrea De Salve, Paolo Mori, and Laura Ricci. 2018. A survey on privacy in decentralized online social networks. Computer Science Review 27, (February 2018), 154–176. DOI:https://doi.org/10.1016/j.cosrev.2018.01.001

[2]Morten Falch, Anders Henten, Reza Tadayoni, and Iwona Windekilde. 2009. Business Models in Social Networking. unknown. Retrieved May 21, 2023 from https://www.researchgate.net/publication/242178725_Business_Models_in_Social_Networking

[3]Borko Furht (Ed.). 2010. Handbook of Social Network Technologies and Applications. Springer New York. Retrieved May 21, 2023 from https://link.springer.com/book/10.1007/978-1-4419-7142-5

[4]Robert W. Gehl and Diana Zulli. 2022. The digital covenant: non-centralized platform governance on the mastodon social network. Information, Communication &#38;amp; Society (December 2022), 1–17. DOI:https://doi.org/10.1080/1369118x.2022.2147400

[5]Lucio La Cava, Sergio Greco, and Andrea Tagarelli. 2021. Understanding the growth of the Fediverse through the lens of Mastodon. Applied Network Science 6, 1 (September 2021), 1–35. DOI:https://doi.org/10.1007/s41109-021-00392-5

[6]Page Laubheimer. 2019. The 3-Click Rule for Navigation Is False. Nielsen Norman Group. Retrieved May 21, 2023 from https://www.nngroup.com/articles/3-click-rule/

[7]Page Laubheimer. 2023. Onboarding Tutorials vs. Contextual Help. Nielsen Norman Group. Retrieved May 21, 2023 from https://www.nngroup.com/articles/onboarding-tutorials/

[8]Kate Moran. 2019. Usability Testing 101. Nielsen Norman Group. Retrieved May 21, 2023 from https://www.nngroup.com/articles/usability-testing-101/

[9]Jakob Nielsen. 2000. Why You Only Need to Test with 5 Users. Nielsen Norman Group. Retrieved May 21, 2023 from https://www.nngroup.com/articles/why-you-only-need-to-test-with-5-users/

[10]Jakob Nielsen. 1998. Paradox of the Active User. Nielsen Norman Group. Retrieved May 21, 2023 from https://www.nngroup.com/articles/paradox-of-the-active-user/

[11]Thomas Paul, Antonino Famulari, and Thorsten Strufe. 2014. A survey on decentralized Online Social Networks. Computer Networks 75, (December 2014), 437–452. DOI:https://doi.org/10.1016/j.comnet.2014.10.005

[12]Qamar. 1AD. Centralized to Decentralized Social Networks: Factors that Matter. IGI Global. Retrieved May 21, 2023 from https://www.igi-global.com/gateway/chapter/143338

[13]Aravindh Raman, Sagar Joglekar, Emiliano De Cristofaro, Nishanth Sastry, and Gareth Tyson. 2019. Challenges in the Decentralised Web. ACM Conferences. Retrieved May 21, 2023 from https://dl.acm.org/doi/10.1145/3355369.3355572

[14]David G. Schwartz, Inbal Yahav, and Gahl Silverman. 2016. News censorship in online social networks: A study of circumvention in the commentsphere. Journal of the Association for Information Science and Technology 68, 3 (June 2016), 569–582. DOI:https://doi.org/10.1002/asi.23698

[15]Lorenz Schwittmann, Matthäus Wander, Christopher Boelmann, and Torben Weis. 2014. Privacy Preservation in Decentralized Online Social Networks. IEEE Xplore. Retrieved May 21, 2023 from https://ieeexplore.ieee.org/document/6685803

[16]Kinneret Yifrah. 2017. Microcopy: The complete guide.

[17]Haris Bin Zia, Jiahui He, Aravindh Raman, Ignacio Castro, Nishanth Sastry, and Gareth Tyson. 2023. Flocking to Mastodon: Tracking the Great Twitter Migration. arXiv.org. Retrieved May 21, 2023 from https://arxiv.org/abs/2302.14294

[18]mastodon/mastodon: Your self-hosted, globally interconnected microblogging community. GitHub. Retrieved May 21, 2023 from https://github.com/mastodon/mastodon

[19]Servers. Mastodon. Retrieved May 21, 2023 from https://joinmastodon.org/servers

[20]ActivityPub. Retrieved May 21, 2023 from https://www.w3.org/TR/2018/REC-activitypub-20180123/

[21]User Onboarding. UserOnboard. Retrieved May 21, 2023 from https://www.useronboard.com/

[22]Mastodon Help. Instances. Retrieved May 21, 2023 from https://mastodon.help/instances?exnox=0&exregc=0&exappr=0&exlcko=0&lang=112&desc=&minu=&maxu=&minau=&minc=&ord=tusersd&p=10

[23]mastodon/LICENSE at main · mastodon/mastodon. GitHub. Retrieved May 21, 2023 from https://github.com/mastodon/mastodon/blob/main/LICENSE

[24]Mastodon Server Covenant for joinmastodon.org. Mastodon. Retrieved May 21, 2023 from https://joinmastodon.org/covenant

[25]The growth of Diaspora - A decentralized online social network in the wild. IEEE Xplore. Retrieved May 21, 2023 from https://ieeexplore.ieee.org/document/6193476

[26]The Good Left Undone: Advances and Challenges in Decentralizing Online Social Networks. Computer Communications 108, 36–51. DOI:https://doi.org/10.1016/j.comcom.2017.04.008