Awareness, Navigation, and Use of Feed Control Settings Online

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ABSTRACT
Control settings are abundant and have significant effects on user experiences. One example of an impactful but under-studied area is feed settings. In this study, we investigated awareness, navigation, and use of feed settings. We began by creating a taxonomy of feed settings on social media and search sites. Via an online survey, we measured awareness of Facebook feed settings. An in-person interview study then investigated how people navigated to and chose to set feed settings on their own feeds. We discovered that many participants did not believe ad personalization feed settings existed. Furthermore, we discovered a misalignment in the expectation and the function of settings, especially in ad personalization settings for many participants. Despite all participants struggling to find at least one setting, participants overall wanted to use settings: 94% altered at least one setting they encountered in our study. From these results, we discuss implications and suggest design guidelines for feed settings.

Author Keywords
control; settings; feeds; social media

CCS Concepts
•**Human-centered computing** → **User models;** *HCI design and evaluation methods; User studies;* Usability testing;

INTRODUCTION
Currently, a significant number of people consume information presented in feeds found on online platforms such as Facebook, Twitter, and YouTube. As feeds have proliferated, so have the control settings for them. For instance, since its founding, Facebook has introduced many feeds or feed-like features, including the News Feed, notifications, Messenger, Marketplace, Stories, and Dating. Many of these new features have settings that control them, increasing the number of feed control settings available to users.

Well-designed feed settings have many beneficial and valuable effects. First, feed settings increase user satisfaction [49] and satisfy users' desire for control [11, 15]. Enabling users to help construct more engaging feeds not only aligns with their interests, but also the feed providers' interests, as many

feeds include ads. Second, designers recommend the inclusion of control settings in software that incorporates AI [6]; these guidelines would apply to the many feeds that are now algorithmically curated. Feed control settings are one of the ways users understand feed curation algorithms [14]. In short, control settings can help improve the algorithmic experience found on many feeds [5, 4].

But for users to benefit from feed control settings, they need to be aware of them, be able to find them, and understand their function. Thus, we investigated issues of awareness, navigation, and usage in feed settings. For the purposes of this study, we define a "feed" as dynamic, frequently-updated content that is presented in a list-like format. Examples include Facebook's News Feed, search results, notifications on websites, reviews for products, and private messages.

First, we developed a taxonomy of the settings on major social media and search sites with feeds, and used it to inform us of typical design patterns and to determine which settings controlled feeds. We then investigated awareness, navigation, and usage issues in feed settings, using Facebook as a platform. To measure awareness, we asked participants about the existence of 35 examples of Facebook settings in an online survey. To find navigational difficulties, we conducted an in-person study in which 36 participants were tasked with navigating to a sample of feed settings on Facebook. Finally, to investigate usage issues, we took the same participants on a guided tour in which they could alter their feed settings.

Around half of participants who took the online setting existence survey performed no better than random. A majority of participants assumed that ad personalization settings for feeds did *not* exist on Facebook. In our in-person study, all participants struggled to find at least one setting. In addition, many participants interpreted the functions of settings incorrectly. Nonetheless, participants wanted to use settings. 94% of participants altered at least one setting during our guided tour of Facebook feed settings.

Our results suggest that while websites with feeds have provided settings that people want to use, designers and website owners can do more to educate users about feed settings and to make the settings easier to find and understand. We conclude by creating a set of guidelines that can help fulfill these goals.

RELATED WORK
Related work falls into four major topics: the role of settings in general user interface design, privacy settings, the importance of feed settings, and navigating and finding control settings.

Settings in User Interface Design

There exists substantial literature on the design of hardware controls, from everyday appliances [33] to safety-critical systems like cockpits and nuclear power plants [44, 32]. But for settings in graphical user interfaces, advice is mostly limited to general design principles, such as to perform cognitive walk-throughs [26] and to design settings as analogues to hardware controls [33]. Raskin urges caution when designing settings, which he considers as an aspect of modal software: "if you design a modal interface, users will make mode errors" [37]. While Raskin offers valuable guidance for reducing mode errors, there is little guidance for improving users' awareness, navigation, or comprehension of settings. Others have successfully experimented with designs to help users comprehend large numbers of Facebook privacy settings, but the designs are limited to privacy settings that fit a particular schema of information sharing [47, 29].

Privacy Settings

One example of an area of settings that has received significant study is privacy settings because of their effects on user privacy and security. Prior work has found that significant numbers of users are unaware of privacy settings, or have privacy settings that violate their wishes, especially on Facebook [2, 27, 28, 54, 24]. The usage of privacy settings constantly evolves as social media sites revise their interfaces and privacy issues receive more scrutiny [48, 12]. In 2006, Acquisti and Gross reported that 22% of users were unaware of their privacy settings [2]. However, Stutzman et al. notes a decreasing trend of information sharing on Facebook from 2005 to 2011 that corresponded to growing awareness of privacy issues; for instance, public birthday sharing among users decreased from 86% to 13% [48]. Still, there are many opportunities for privacy setting errors. Stutzman et al. noted that from 2009-2010, sharing for certain information like interests *increased*, likely due to interface and policy changes in Facebook around that time [48]. A significant minority of people are still unaware of privacy settings – according to a 2018 Reuters poll, 74% and 55% of Facebook and Twitter users self-reported being aware of their current privacy settings, respectively [23].

Percentages only partially capture setting usage and how different types of people interact with settings. Melicher et al., via interviews, found that participants wanted to control how they were tracked online for advertising, but many were unwilling to put in the effort or felt such efforts were futile [30]. These findings hint at nuanced complexities in how people use and perceive ad settings. Wisniewski et al. [54] conducted a survey of Facebook users that asked which privacy settings they used and how often, and described several categories of privacy behaviors. Our work expands the existing body of literature on the usage of settings into the non-privacy domain. Our findings are informed by data obtained from existing feed sites and via in-depth interviews and surveys of people as they are observing their social feed.

The reasons for the difficulty of managing privacy settings are numerous and complex. A sample of only some of these include simple unawareness [54], a psychological tendency to use the defaults [43, 13], insufficient knowledge to make informed decisions [1, 24], interfaces that are too complex [47, 18], anchoring and framing effects [3], and the difficulty of interpreting and anticipating what the settings will do [51, 36, 29]. We expand the evaluation of such issues to feed settings.

Feed Settings

Feed settings hold an important role in user satisfaction and the design of software. First, feeds and feed settings are abundant, with feeds appearing on major sites like Facebook, Google, YouTube, and Twitter.

Second, feed settings have many beneficial and valuable effects. Vaccaro et al. [49] found that Twitter users were more satisfied with their feeds if control settings were present and visible, regardless whether the controls worked or not. Researchers have made tools like WeMeddle [20] and Gobo [8], with the aim of helping people have more control over their feeds. Facebook has stated they provide News Feed settings to help "show you the stories that matter most to you" [15], and of course, social media providers also have a vested interest in more engaging feeds, as the feeds include ads.

Third, designers have pushed for the inclusion of control settings into software that uses AI, and feeds are no exception [6]. In general, these settings can help support users' desires to make corrections to system output, provide feedback, and customize system behavior [6, 5]. In the context of feeds, Burrell et al. found that Twitter users desired control for privacy purposes, to protect from abuse and harrassment, and more [11]. Eslami et al. found that feed settings can help users understand how feed curation algorithms work [14].

On the other hand, many of the settings that control algorithmically curated feeds have ambiguous and hard-to-validate functions, such as "show me the best Tweets" on Twitter or "Not interested [in video recommendation]" on YouTube. While there has been some work on how users understand and interact with these types of settings [49, 4], many questions remain about their design and role in recommender algorithms.

In addition, we wanted to investigate feed settings to see if issues of awareness and usage found in privacy settings generalized to feed settings. There have been hints of such issues in feed settings. For example, the New York Times recently published an article on how to adjust notification settings [38] because it was not straightforward. Eslami et al. found that over half of participants were unaware that an algorithm curated the News Feed [14], despite the existence of feed settings (for example, an option between "Top Stories" and "Most Recent") that gave strong clues to the presence of this curation. Furthermore, the participants that had opted to sort their news feeds chronologically rather than by "Top Stories" were not aware that the setting automatically reverted back to "Top Stories" after some time. Settings that expire, like the muted word and hashtag settings on Twitter, exist in several social media sites today and raise new questions about setting interpretability.

Finding Control Settings

Even if people were aware of settings, the benefits would be meaningless if people could not navigate the site to find them.

Grossman et al. identified unawareness of features and trouble finding features as some of the major issues contributing to the difficulty of learning software [21]. To our knowledge, there has been no prior work exploring how people find control settings, however, reserachers have explored information-finding. For example, Pirolli discusses "information scent", that is, textual and graphical cues that exist on links that will bring users closer to the information they seek [35]. A "good" information scent reduces the number of irrelevant pages people visit while trying to find information, and has been mathematically modeled to predict people's navigation paths with reasonable accuracy [17]. Accordingly, Spool et al. discuss a variety of information scent guidelines, such as providing concise and easily understandable *trigger words*, or words that users understand as information scent [46].

One cause of navigation difficulties is visual complexity. Geissler et al. found that an "inverted U-shape" relationship exists between website complexity (page length, number of links, number of images, etc.) and attention and cognitive load [19], especially when people are given complex tasks [52]. Others have focused on expectations of where common UI elements, such as login buttons, should be located [7, 39, 40]. These expectations, or mental models, evolve as new design conventions gain popularity [22]. Layouts that fail to conform to expectations can cause increased mental workload and decreased task performance [34], as well as disorientation, at least at first [41].

Presumably, online visual complexity, layout, and information scent affect the findability of settings, but these models have not been tested on settings specifically. We argue that setting finding has different characteristics than information finding. People have more specific expectations of where settings are located and how they are structured compared to general information, and settings pages tend to be more structured than pages that contain information. In addition, while the search engine plays an important role in information finding [35], we expect a lesser focus on search engines while finding settings. Nonetheless, information foraging ideas have informed our analysis of the problems that people encountered while finding settings.

Research Questions

Given the importance of feed settings, we decided to study the settings that controlled the viewing or consumption of feeds online. Note that this excluded settings that controlled the *production* of feed content. During our investigation, we uncovered hundreds of feed settings. As we classified them into production and consumption categories, we chose to focus on feed consumption settings, given how feed consumption and feed curation influence society today [9]. To help decide what was a "feed setting" and inform our experiments, we first conducted a survey and taxonomy of settings on major websites with feeds by asking:

RQ1: What categories of feed control settings exist?

We then conducted several experiments related to feed settings. Given the problems of usage and awareness in privacy settings, we suspected the same might be true for feed control settings. Thus, we asked:

RQ2: What feed control settings do people believe exist?

For settings to be useful, people not only have to be aware of them, but should be able to easily find them. This motivated our third research question:

RQ3: What difficulties do people encounter while finding feed settings?

Finally, we wanted to study the implications of being unaware of feed settings, or being unable to find feed settings. This motivated our final two research questions:

RQ4: Which feed settings do people use?

RQ5: When made aware of feed settings, which settings do people alter?

METHODS

Survey and Taxonomy of Settings

We began with a survey and taxonomy of settings on 11 major desktop social media and search websites to find out what categories of feed settings existed (RQ1). We included the most popular US social media platforms according to Pew Research [45], which included YouTube, Facebook, Reddit, Twitter, Instagram, Pinterest, and LinkedIn. For "search" websites, we added Google and Amazon as they were the most popular US search engine and shopping site, respectively.

For the purposes of this survey, we defined a setting to be *a user interface element that configures, manages, or personalizes a software's behavior*. As mentioned earlier, we excluded settings related to authoring of content.

Using both newly-created and personal accounts, we manually inspected each website, collecting data on settings as comprehensively as possible. At the minimum, on each site we explored menus and gear icons related to the following areas if applicable: main account settings, posts/results on the main feed, private messaging system, friend request or follow system, other accounts' profile pages, and notifications. We created new accounts on these websites to record default settings. Besides defaults, we noted the date of collection, names of the settings, any explanations for the settings' function, and the most direct navigation path to each setting, excluding password input and confirmation dialogues. Navigation path data included coordinates and sizes of each of the buttons and menus in the path.

While a best-effort was made to record settings as comprehensively as possible, we cannot guarantee that we catalogued every setting on every website, especially if the site had settings only available to users who had performed a certain action. For example, text messaging frequency settings are only visible to Facebook users who have added and verified a phone number. However, we are confident that we recorded the vast majority of settings that are available to new users of each site.

To determine what categories of settings existed on the nine major social media and search websites, we collected 481 examples of settings (excluding feed production settings) between September 4, 2018 and October 27, 2018. Once all data

for settings was collected, two coders independently assigned a category of function to each setting. A codebook was developed iteratively; the coders initially coded 15% of the settings and then met to discuss and refine the codes. This process was repeated until consensus was reached. Once the codebook was finalized and the two coders had finished, conflicts were resolved with discussion and a third independent coder. The final codebook had 20 categories of settings; intercoder reliability was 86% (Cohen's kappa = 0.85).

We further filtered our settings by selecting categories that related to controlling or viewing feeds. This process was similar to that of the codebook creation. These feed settings became our dataset for the remainder of the study.

Existence of Settings Survey
For this and subsequent experiments, we used Facebook as a platform because of its ubiquity and familiarity among the population of the US, and because it possessed numerous feed settings with analogues in other major social media websites.

To investigate what settings people believed existed (RQ2), we ran an online survey on Amazon Mechanical Turk that asked participants about their beliefs in the existence of 35 examples of settings on Facebook. These examples reflected the different categories of feed settings uncovered during the settings survey, and the different kinds of content on Facebook (posts on the News Feed, notifications, private messages, ads).

24 of the examples referred to existing settings, and 11 referred to non-existing settings. The inclusion of non-existing settings enabled us to better assess knowledge and tell the difference between those who thought almost all settings existed, and those who had a more nuanced understanding of what settings existed. Some of the non-existing settings were based on existing settings found on other social media platforms.

Setting existence questions were randomized and worded, "On the desktop version of Facebook, do you think a setting or group of settings exists to ___?" Possible responses were "I think it exists" and "I think it doesn't exist." In addition, we assessed the participant's confidence in the response with a four-point Likert scale; possible responses ranged from "Not at all confident" to "Very confident."

After submitting the initial responses, participants reviewed questions that they had answered with the lowest confidence level, and could optionally alter their response to "I don't know". We provided the "I don't know" as an option only after low confidence ratings so that participants reflected on their decision before selecting "I don't know."

In addition to collecting data on setting existence beliefs, we collected demographics data, and asked questions pertaining to Facebook-related habits and experience, as we expected participants with more Facebook experience to be more aware of what settings existed. Examples of questions asking about Facebook-related experiences included Likert scale frequency of interaction with various Facebook features like News feed and Marketplace, Likert scale agreement with "Facebook is part of my everyday activity," and whether the participant had ever had a job that involved managing social media.

Likert scale responses were grouped into thematic categories, then coded as integers and summed. We formulated seven factors for input into linear regression to explain participants' setting existence beliefs: age, time spent on Facebook score, feeling of control score, Facebook feature usage score, number of Facebook friends, percent of Facebook time spent on the desktop website, and having had a Facebook-related job.

Participants
86 participants from Amazon Mechanical Turk completed our settings existence survey on August 27, 2019 and August 30, 2019. Nine survey participants (about 10%) failed at least one attention check and were removed from our data set. Two more participants' data was removed because they provided identical responses to every question. This left 75 survey responses, which gave our linear regression analysis a power of 0.8 assuming a medium effect size.

Participants were paid a constant $1.10 per survey completion. On average, participants completed the survey in 8.0 minutes (median=7.0 min, SD=5.1 min), equivalent to an average rate of $8.25 per hour. Participants were diverse in age (mean=34, median=32, SD=10, min=21, max=69) and race (75% white, 15% Asian/Pacfic islander, 9% Black, 7% Latinx, 1% Native American [1]). 67% identified as male, and 33% identified as female, and 0% identified as other or declined to answer. We observed normal distributions in the scores that described time spent on Facebook and frequency of use of Facebook features.

Navigating, Finding, and Altering Settings
In addition to running an online study, we ran an in-person semi-structured interview study to investigate RQ3, RQ4, and RQ5 on the Facebook platform. The interviews were designed to last 75 to 90 minutes, and participants were paid $10/hr.

Participants
We recruited a non-probability convenience sample of 36 participants from the Champaign-Urbana and St. Louis metropolitan areas. Criteria to participate included being over 18 years of age and using the Facebook desktop website. To increase diversity as we recruited, we placed flyers in a variety of public locations such as restaurants, bars, cafes, libraries, and churches. We further recruited online via our university's newsletter and Craigslist. Recruitment proceeded until we achieved a desired balance of demographics and a convergence in participant behavior themes. All interviews were conducted between May 30, 2019 and August 15, 2019, with IRB approval.

53% of our participants identified as female, 47% as male, and 0% as other. Ages varied from 19 to 91 (mean=33.7, SD=17.2). Our sample was relatively young compared to the US population, but every age group had representation: 14 participants were ages 18-24, seven were 25-29, eight were 30-49, and six were 50+. Racially, 42% of participants were Asian, 36% White, 11% Black, 8% Latinx, and 5% preferred not to answer. 11% had a high school diploma or less, 25% had some college experience but no degree, 36% had an associate or bachelor's degree, and 25% had a master's or doctorate degree.

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[1]Numbers add to more than 100% because of mixed races.

Part 1: Navigating and Finding Settings

To gather data for RQ3, we asked participants to attempt six setting-finding tasks on Facebook so we could diagnose difficulties while finding feed settings. The tasks and order were chosen with three aims in mind:

First, we aimed for a variety in the content controlled by the goal settings. To do this, we selected settings that controlled Facebook's oldest and most fundamental content systems: the News Feed, notifications, chat/Messenger, and ads.

Second, we wanted a variety in task difficulty. To anticipate difficulty, we used two criteria: (1) the number of clicks that were required to find a goal setting; and (2) the extent to which the goal setting could be accessed from a relevant Facebook feature, as opposed to only from the main account settings. We included the second criterion because pilot experiments revealed a preference of participants to look for settings directly on the Facebook feature they wanted to control; for example, by trying to prioritize a friend via their profile or going by to the Events feed to find event settings.

Third, we aimed to minimize learning effects. The first way we achieved this was by sorting tasks in order of difficulty. We also ensured variety in user interface areas. To do this, we considered the most direct navigational paths from Facebook's homepage to possible goal settings. We then chose goal settings to minimize overlaps in these paths.

After tasks were finalized, we assigned time limits between one and three minutes for each task, depending on the task's difficulty. Participants attempting the tasks were allowed to exceed the time limit if they seemed to be making progress, but were otherwise asked to stop. The main motivation for time limits was to make interviews more consistent in length, but we also designed time limits to give participants ample time to find settings and demonstrate any difficulties they might encounter.

In order, the tasks were to find a setting to: turn off sounds from private messages, prioritize a friend on the News Feed, turn off birthday notifications, block event invites from one friend, turn off personalized ads based off one's profile information, and permanently delete one's account. There were multiple valid ways to accomplish the first two tasks. Turning off chat sounds could be done in Messenger, or notification settings. Prioritizing a friend could be done not only by using the "Prioritize who to see first" setting, but also by adding a friend to a friends list [42].

While all tasks were possible, participants were told the tasks could be "easy, hard, or even impossible," to avoid influencing their prior setting existence beliefs. To give participants a familiar environment, they logged into their personal Facebook accounts, and could use the interface in any language.

For each task, participants started from Facebook's homepage, which displayed the News Feed. They were then given a description of the task, and allowed to freely navigate and do anything they wanted in the web browser, including searching on Google. Tasks ended when a participant found a setting that they felt would successfully accomplish the task, when the participant gave up, or when the experimenter stopped the participant because they exceeded the task's time limit.

Participants were additionally instructed to think out loud as they navigated. To assist participants as they explained their navigation decisions, we recorded the screen and allowed participants to review recordings of their actions as needed; screen recordings were deleted immediately afterwards to protect privacy.

Part 2: Guided Tour of Settings

The second part of the in-person study addressed RQs 4 and 5, which aimed to answer which feed settings people had used and what settings people wanted to change. We guided participants on a comprehensive tour of feed settings on Facebook. For each setting, we asked if the participant recalled using the setting before, and recorded the state or value of the setting if applicable (dropdowns, toggles, and lists have well-defined states, but buttons like "Hide post" do not). Settings with states other than the defaults were likely to have been changed by the user.

To answer RQ5, we asked participants if they wanted to change each setting, and recorded the new states of the settings if they did decide to change a setting. During this process, we avoided explaining what the settings did without solicitation. We only explained the setting if asked, or it became apparent that the subject did not understand the setting. This helped us find differences between participants' understanding and the actual function of settings, if such differences existed. We did not ask participants if they wanted to use button-style settings like "Hide post," we expected the reasons for using such settings to be highly contextual, requiring participants to think hypothetically – a difficult task.

All participants toured settings in the same order: News Feed preferences, chat preferences, blocking settings, ad preferences, language preferences, and finally notification settings. While privacy research has noted that framing effects can affect preferences [3], we did not expect any framing effects because each area of settings tended to control unrelated systems on Facebook.

After the tour, we asked participants about their overall experience, gathered demographic data, and told participants the purpose of the study.

Qualitative Data Analysis

Interviews were recorded and transcribed with participants' consent. Participants' explanations for their actions in Part 1 underwent an open coding process to find themes in navigation difficulties (RQ3). Similarly, we used an open coding process to find themes in participants' explanations for altering or not altering settings in Part 2, which helped answer RQ5.

RESULTS

Coding of settings on feed websites revealed nine categories of feed settings, which we then used in our experiments. Responses for the setting existence survey showed that participants were unaware of many feed settings, especially ad personalization settings. Participants experienced numerous difficulties while trying to find settings, not only from structural

issues but from misunderstandings of the settings' function. Finally, 94% of participants changed at least one setting, including many changes in ad settings, but many continued to misunderstand the functions of settings.

Categories of Settings (RQ1)

Sites we explored varied greatly in the number of settings exposed to viewers, ranging from 120 settings catalogued on Facebook to 20 on Instagram. From the initial categories of 20 settings, we produced a list of nine categories we considered to be "feed settings" (see supplementary Table 1). Some of the categories were clearly related to feeds, but other categories were included for their indirect effects on feeds. For example, account deletion settings were included because if a user were to delete their account, they would lose access to all their feeds. Feed settings from our filtered categories became our dataset for the remainder of the study, which used Facebook as a platform.

Feed Setting Existence Beliefs (RQ2)

Our survey to understand feed setting existence beliefs on Facebook totaled 35 questions where possible replies were "I think it exists," "I don't think it exists," and "I don't know." When a participant's existence response aligned with the existence of the feed setting, we termed the survey response "correct." On average, participants answered 23 out of 35 (66%) setting existence questions correctly, with a SD of three questions. "I don't know" responses were relatively uncommon; 83% of people had 2 or fewer "I don't know" responses.

Using accuracy as a metric had some shortcomings because of the imbalance of non-existing and existing settings. Our survey listed 24 existing and 11 non-existing settings. A participant who responded that every setting existed would answer 24 questions correctly, but would arguably demonstrate less awareness of feed settings than a participant who answered 24 questions correctly but was also able to somewhat discriminate the existing from the non-existing settings.

Thus, we calculated the Matthews correlation coefficient (MCC) for each participant. MCC is a robust binary classification metric [10] that ranges from -1 to 1. An MCC of 0 corresponds to predictions that are no better than random; a set of identical responses to every question would also result in an MCC of 0. The average participant's MCC was 0.285 (SD=0.219, min=0.176, max=0.752). 38 participants (51%) performed statistically no better than random. Although nine participants (12%) had an MCC less than 0, no participants performed statistically *worse* than random.

Figure 1 illustrates the patterns of answers. Participants predominantly fell into three broad categories: "skeptics" who believed most settings didn't exist (left columns), "optimists" who believed most settings did exist (right columns), and those in between.

We noticed that existence responses depended on the category of setting being assessed. For example, many participants did not believe data curation and ad settings existed, causing many true and false negatives (middle box in Figure 1). On the other hand, a much higher proportion of participants believed

in the existence of notification settings and feed tweaking settings. Existing settings in these categories garnered many true positives (bottom box), but there was limited success in detecting the non-existing settings in this category (top box). Since some of the non-existing settings were based on existing settings found on other social media platforms, it was possible that familiarity with social media websites partially caused this pattern, but the settings that did not exist on any platform (to our knowledge) had just as many false positives. Another category of settings that most participants believed existed were settings related to account deletion. Settings about deletion and deactivation of Facebook accounts were in the bottom box, but the setting about "deleting your activity log" was the non-existent setting with the second most false positives.

Prior Experience Only Explained Confidence

In addition to investigating the categories of settings, we investigated whether the factors of Facebook-related habits or age explained participants' responses. We found no links between MCC and any of the factors, but we did find significant links between participants' confidence levels (the number of questions marked "confident" or "very confident") and the factors of *having a Facebook-related job* (coeff=4.9, p=0.003) and *time spent on Facebook score* (coeff=0.6, p=0.04). However, confidence levels were not significantly correlated with accuracy (Pearson r=0.134, p=0.25). In other words, spending more time on Facebook and having a Facebook-related job were associated with being more confident in one's responses, but not with more accurate responses. In general, being more confident did not suggest better accuracy.

Difficulties in Setting Navigation (RQ3)

The first part of our in-person study investigated the difficulties people encountered while finding settings on Facebook (RQ3).

Different Versions of Facebook Settings

While all interviews occurred in the same time period, we noticed not all participants viewed the same notification settings, as Figure 2 illustrates. In fact, over a period of a few weeks, the proportion of participants that encountered the new notifications settings increased. 13 participants, mostly in the early stages of interviews, encountered the old interface. The latter 23 participants encountered the new notification interface.

Two of our tasks had goal settings in the notification settings. For the task of finding a setting to turn off private message sounds, participants that encountered the old interface took an average of 34 seconds to complete the task, while participants that encountered the new interface took an average of 73 seconds. On the other hand, for the task of turning off birthday notifications, there was no significant difference in task times. We discuss the reasons for these differences in our analysis of the difficulties participants encountered.

Another, less dramatic change was the location of the account deactivation setting. In the old version, account deactivation was classified under the "General" heading of the main settings, but the new version classified it under "Your Facebook Information," moving it alongside the permanent account deletion setting. During the task to delete one's account, only four
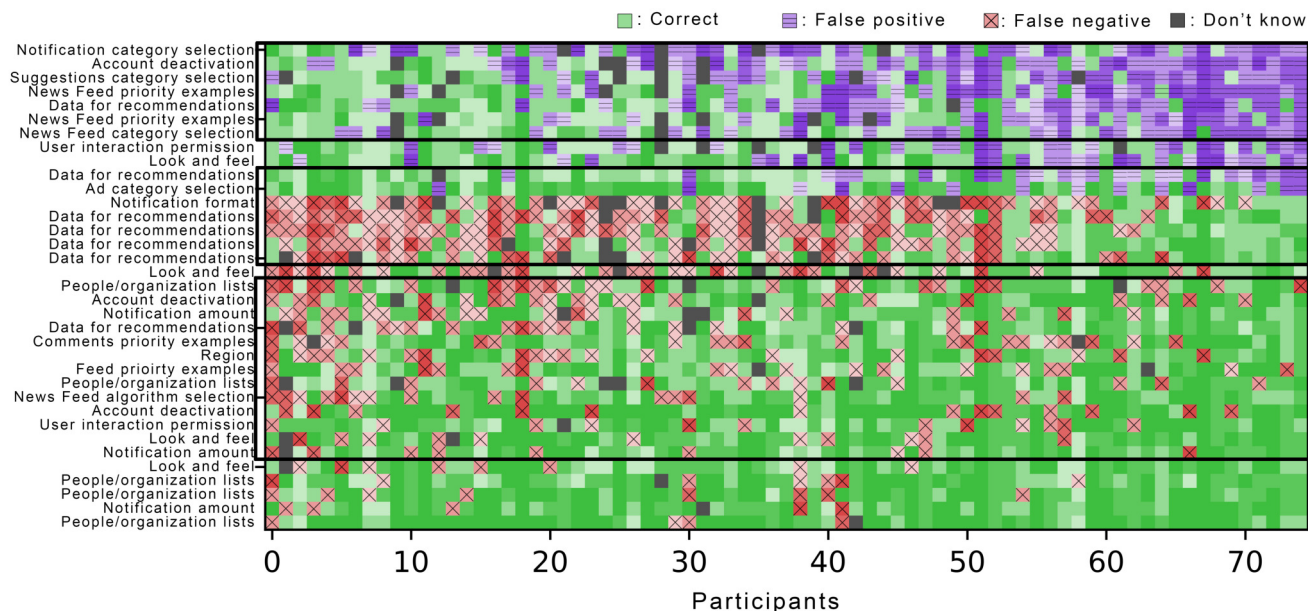
Figure 1. Overview of existence beliefs for feed settings on Facebook from our MTurk survey. Each row represents one question about the existence of a feed setting, and each column represents one participant's responses. Each row is labeled with the relevant category based off our setting catalogue; the original questions and category definitions are in the supplementary tables. Correct responses are rendered green with no texture, false positives (only possible with non-existing settings) are rendered purple with a '=' texture, false negatives (only possible with existing settings) are rendered red with an 'X' texture, and "I don't know" responses are rendered black. Darker shades indicate higher confidence levels in the response. Boxes represent interesting clusters. Top box and bottom box: many believed that notification and feed tweaking settings existed. Middle box: many disbelieved the existence of ad personalization (data for recommendations) settings.

participants encountered the new organizational scheme. We discuss the implications of this change later in this section.

Difficulties Participants Encountered
35 participants had qualitative data available for analysis. We found several themes in the difficulties they encountered:

Mistaken associations (N=35). Effective ways participants found settings included (1) opening menus and headings that seemed to have an association with the task at hand, such as clicking a heading that said "notifications" while trying to turn off birthday notifications; and (2) going to known pages they expected would contain the settings, such as going to a friend's page to prioritize that friend. However, all participants had at least one incident of these associations or expectations not being borne out in the interface, which wasted time and increased frustration. For example, while searching for a way to turn off birthday notifications, many clicked on the Events shortcut from Facebook's homepage, reasoning, "birthdays are events, that might have something" (P7). Other examples include going to privacy settings while trying to turn off profile-based ad targeting, and going to a friend's page to block event invites from that friend. All these interfaces, in fact, did not contain the settings that participants desired.

A common cause of this issue (N=24) was buttons or headings that contained keyword(s) in the task description. For example, many clicked on the "Events" shortcut in the homepage while trying to block event invites, and many clicked on the menu option labeled "Advertising on Facebook" while trying to accomplish the ad-related task. These links were especially attractive, but functioned as red herrings, leading people away

from settings that would complete the task, although people usually realized quickly that they were in the wrong area.

Trial and error (N=32). Almost all participants incorporated trial and error or wild guessing while finding settings, especially after exhausting other navigation possibilities. However, this method was less effective at finding settings. Examples of inefficient strategies included:

- Opening dots and gears. Most participants knew that triple-dots and gear icons opened settings menus, however, participants often wasted time trying them regardless of context. Some participants even clicked on Chrome's triple-dot settings, not realizing they were associated with the Chrome browser and not Facebook.

- Iterating sequentially through many options, or clicking the first or most salient option. More often than not, relevant links were nearer the bottom.

- Visiting the familiar. Some participants revisited setting pages which proved successful for previous tasks.

Fruitless keyword searching (N=24). While the previous difficulty involved making associations that were not borne out in the interface, this issue describes people *not* making an association when one was needed. This usually manifested as actively searching for a keyword that did not exist on the page.

This theme partially explained why participants had more difficulty finding a setting to turn off private message sounds on the new notification setting interface compared to the old one (Figure 2). 68% that viewed the new notifications interface tried to find a heading that mentioned the word "sound" or
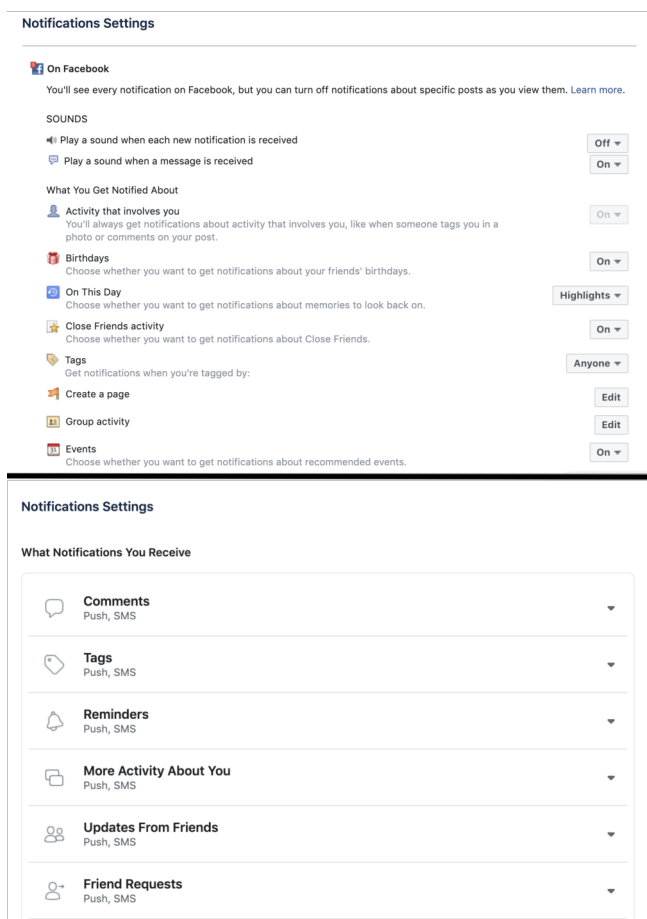
Figure 2. Comparison between Facebook's old (top) and new (bottom) notification settings pages.

"messages," but failed. In actuality, the sound settings in the new notifications interface were categorized under "Browser," which was located near the bottom (this heading is not visible in the figure). In contrast, people easily found the sound settings in the old interface, and this theme appeared only 23% of the time.

For the task of turning off birthday notifications, birthday notifications existed as a heading in the middle section of both the old and new interfaces, so there was little difference in the proportion of participants that encountered this difficulty.

Backtracking; being unsure (N=22). Many participants went back to pages and menus that they seen before in the same task to verify they had not "missed" something. This required extra time.

Unseen elements (N=20). Participants often missed important menus, headings, and settings due to a variety of reasons, such as insufficient visual salience, not paying attention, focusing too much on finding one keyword, and/or time pressure. For example, many missed the "Ads" heading in the main settings when trying to find a setting that turned off profile-based ad targeting.

Failing to recreate past actions (N=7). Some participants felt that they had done certain tasks in the past, and let mem-

ory guide their actions. While this was sometimes an effective strategy, other times it led participants away from the correct settings, either because of faulty memories, or possibly because interface updates changed the location of settings.

Unhelpful search results (N=6). Some participants turned to Google or Facebook's Quick Help after an unsuccessful search on the Facebook interface or because of a fear of difficulties. While searching was often useful, many used sub-optimal search terms and/or encountered unhelpful search results. For example, when P3 searched how to delete their account on Google, the first result was instructions on how to *deactivate* one's account. This led P3 to believe that account deletion was impossible: "It confirmed what I was thinking."

Prior doubts of existence (N=2). We encountered two instances of participants refusing to do a task because of a strong prior belief in the task's impossibility. P5 declined to find a setting that turned off profile-based ad targeting, believing it was "not possible because ... the Zuck wants money and ads are how he does it." P34 declined to find an account deletion setting, believing "Facebook holds on to you for the rest of it's existence."

Finding the Wrong Setting
Many participants ended tasks by selecting a setting or user interface element whose function did not actually accomplish the task. Sometimes this was because a participant was short on time and felt they *had* to pick a setting, but many others incorrectly interpreted the function of interface elements. Choosing the "wrong" setting was especially prevalent in the task to turn off personalized ads based off one's profile information (nine participants), and the task to delete one's account permanently (ten participants).

During the task to stop profile-based ad targeting, four participants switched off "Ads Based on Data from Partners," despite being told to find a setting that controlled the data that the participants had manually added to their accounts (Facebook used the word "Partners" to refer to "data we receive from partners about your offline activity"). The rest of the participants chose a variety of other settings, such as a setting that disallowed facial recognition, and a setting that disallowed search engines to link to one's profile. P36 even thought the search box in "Quick Help" was a way to send a personal request to Facebook to "tell them to delete my personal history."

During the task to delete one's account permanently, ten participants chose the account deactivation setting, which only temporarily "deleted" accounts. Of the ten participants, two selected the deactivation setting because they believed a permanent deletion setting did not exist. The other eight participants thought that deactivation would truly accomplish permanent account deletion. None of the four participants that encountered Facebook's new grouping of deactivation and deletion settings made this error. Grouping the settings together could mitigate confusion by giving more opportunity for comparison, but more participants would be needed to confirm.

Settings Participants Used (RQ4)
To determine what settings people had used (RQ4), we compared the states of participants' feed settings on Facebook with

the defaults. One participant was unable to complete this part of the study, leaving 35 participants' data for analysis.

All remaining participants had at least one setting with a non-default state. 90% of participants had at least one non-default setting in the notification settings and News Feed preferences. The large number of non-defaults in the news feed preferences was due to high use of the "unfollow" feature – 86% had a non-empty unfollow list.

Around 50% of participants had at least one non-default state in their ad preferences page, although for 15% of all participants, the only change was blocking an advertiser, which could be done from the News Feed in addition to the ad preferences page. Only around 35% of participants had changed at least one setting that was exclusively contained in the ad preferences page.

Participants' memory of whether they had used settings was often unreliable, which often surprised participants. For instance, P35 stated that "I like to know a variety of people, and so I refuse to unfollow people," but then discovered some people on their unfollow list. P19 was surprised to find out their mother was unfollowed: "I don't know why she's on there. I'm assuming I must have done that by mistake."
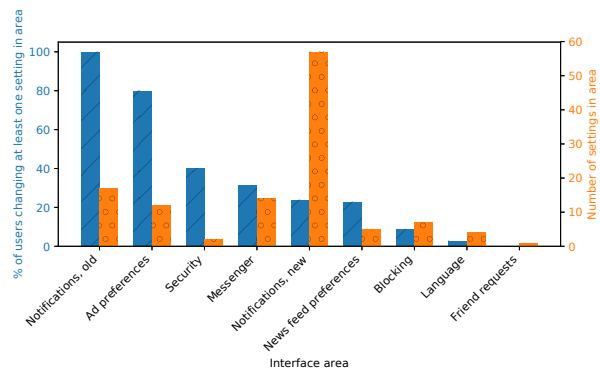
Settings Participants Changed (RQ5)
To answer RQ5, we allowed participants to alter their feed settings. 33 out of 35 (94%) participants changed at least one setting during the study. Figure 3 illustrates the interface areas in which participants changed at least one setting.

All 13 participants who encountered the old notification setting page changed at least one setting, while only about 20% of participants who encountered the new notification settings changed at least one setting. A possible reason is because of the larger number of settings on the new notification settings page, participants scrutinized each setting less carefully.

Around 80% of participants altered at least one setting in the ad preferences page. 14 participants (40%) chose to disallow ads based on data from "partners" or other Facebook company products. There was a variety of stated reasons, but the most common included a perceived gain of privacy, or a stronger sense of control.

Another common action was removing an ad interest, which was an advertising topic that Facebook inferred participants would be interested in. 20 participants (57%) removed at least one ad interest. The primary reason participants removed ad interests was that Facebook's inferred interests did not reflect participants' actual interests.

Often, participants misunderstood the function of ad settings. Eight participants (23%) thought that turning off ad personalization, removing ad interests, or removing advertisers would reduce the number of ads on Facebook, when in fact this was not true. Eight participants (23%) thought that turning off ad personalization would stop Facebook from sharing personal information with advertisers, but Facebook states that advertisers do not have access to personal information.

Figure 3. Interface areas in which participants chose to change settings. Blue solid bars represent the percentage of participants that chose to change the state of *at least one* setting in the area during our study. Orange textured bars represent the number of settings in the interface area.

Reasons for Not Changing Settings
While reasons for altering a particular setting were highly dependent on the setting's function, there were several reasons for *not* altering settings that were common to all settings.

Having no preference. The most common reason for not changing a setting was not having a problem with the state, or having no preference. Common ways of expressing this were "I just don't care at all" (P4), "if it ain't broke, don't fix it" (P7), "I don't see any reason to change it" (P25), and 'it wasn't bothering me" (P30). Changing such settings would be equivalent to spending effort for no gain, and is a demonstration of the influence of defaults. A common cause of not having a preference was not using or encountering the corresponding Facebook feature. For example, P5 declined to change the skin tone of emojis because they didn't use emojis. P30 declined to change email frequency because they never checked the email address associated with their Facebook account.

Having a preference. If a participant liked a setting's state or gained some benefit from it, then they obviously would not change it. The reason for the liking or benefit depended very much on the setting. For example, many left birthday notifications on (the default state) because they liked to be reminded of birthdays.

Not understanding a setting. Participants were unlikely to change settings they did not understand. The setting to encrypt notification emails with PGP was a common example, as many did not know what PGP was. Another example was the chat settings, which confused participants because most of the settings had no explanations for their function.

DISCUSSION
In our study, we found that many participants were unaware of their feed settings, and had difficulty navigating and understanding feed settings, especially ad settings. This is of particular concern as ads and typical posts are indistinguishable to many users [53]. Based on our findings, we discuss potential ways to better the design of feed settings.

Implications of Feed Setting Unawareness
The responses to our feed setting existence survey suggest that many consumers of feeds are unaware of the control available

to them via settings. Participant feedback at the end of our in-person study reflected this gap in knowledge: 91% described their overall experience in the study as "informative," "eye-opening," "enlightening," "interesting," or likewise. This was further evidenced by the number of participants that changed settings when they encountered them.

Similar to privacy setting education–Google and Facebook have introduced "Privacy checkups" to help educate users and ensure user satisfaction with privacy settings–we argue websites should educate users about feed settings, even though it is a difficult task. Future work can investigate approaches such as informing users of settings that their friends use, or contextually presenting information about settings which are predicted to benefit the current user. Such nudges have shown promise in educating users about privacy settings [1] and desktop application features [16].

Misunderstandings and Trust of Settings

We uncovered many flaws in how participants understood feed settings. Sometimes, participants misunderstood settings which had no explanation at all, which were primarily in Facebook's chat settings. In those cases, the solution would be straightforward: feed settings should have explanations.

A more worrisome behavior was using settings based on a flawed understanding of their function, despite an explanation of the setting. Some participants tried to use Facebook's ad settings to make fewer ads appear, and permanently delete their accounts with the "deactivate" setting. The effects of these misunderstandings are unclear and deserves further study. In the short term, we expect users to explain away inconsistencies, or blame themselves for not understanding the system well enough, as Vaccaro et al. reported [49]. But in the longer term, there might be a loss of trust due to violations of expectations [25]. In fact, several of our participants expressed mistrust of Facebook's ad settings. For example, P19, stated "I bet that I would still somehow get targeted ads" even if they turned off ad personalization settings. This mistrust recapitulates Melicher et al's findings that many users thought it was futile to control online tracking [30]. Methods for preventing misunderstandings and restoring trust in settings requires further study. One possible approach is *design by contract*, which promotes software components with verifiable effects [31]. Another suggestion is to provide concise and transparent explanations. A current explanation for Facebook's "Ads based on data from partners" setting contains over 153 words of dense prose.

Preventing Setting Finding Difficulties

During the setting-finding part of our study, many commented that finding settings on Facebook was "not intuitive," "tricky," or "complicated for no reason.". Based on participants' difficulties, we propose the following guidelines:

Multiple paths to the same settings. To accommodate the variety of ways people think about settings and the many ways they can be categorized, settings pages should have multiple ways to get to the same setting. An example of this design is on Twitter; it is possible to reach ad settings both through "Privacy and Safety" and "Content Preferences."

A setting search function. Search would mitigate several common themes in setting navigation difficulty, including fruitless keyword searching (69% of participants), backtracking (63%), and unseen elements (57%).

User-controlled setting layout. We noticed that many participants iterated through settings from top to bottom, and that participants did not change settings related to features they did not use, instead relying on defaults. One suggestion to improve navigation efficiency is a mixed initiative approach that assists in laying out the settings that control the feeds or features that the user prefers to interact with. Given the added intricacy and possible unforeseen outcomes of such an approach, more research is necessary to investigate mixed initiative approaches for settings.

Reduce visual complexity. Too many settings on one page increases the likelihood of a user missing an important setting, and increases suspicions that one has "missed" a setting during navigation. One approach to reducing visual complexity is to abstract away the granularity of many detailed settings. Another suggestion is a well-categorized hierarchy of sub-menus. Spool et al. state that "[users] don't mind clicking through large numbers of pages as long as they are getting closer to their goal with each click [46]."

Contextual placement. Participants in our study often chose to *first* look for settings on the feature being controlled. For example, they looked to block event invites from a specific friend by going to that friend's profile. Putting settings on the item being controlled is not completely novel: Vaniea et al. found that putting access-control settings helped users notice privacy setting errors [50].

Generalizability beyond Facebook

Since our user studies were conducted with Facebook as a platform, we cannot guarantee that our participants' behaviors generalize to other websites, especially non-social media websites. However, our taxonomy of feed settings easily extended to Google and Amazon, due to our broad definition of "feed." In addition, future work can study the similarities and differences of non-US sites. For example, an inspection of Weibo revealed a layout of settings similar to Twitter's, yet a lack of settings for how personal data could be used in ad targeting.

CONCLUSION

In this work, we found participants did not know certain Facebook feed settings existed, and believed that certain feed settings existed when they, in fact, did not. We discovered users had difficulties finding settings and understanding extant settings. Websites can do more to make users aware of the feed settings available to them via education, concise text, restructuring of setting presentation, and communicative design. Given the prominence of feeds in our daily lives for news, health, and more, it is time to address this social need.

ACKNOWLEDGEMENTS

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