Unpacking the Social Media Bot: A Typology to Guide Research and Policy

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Abstract

Amidst widespread reports of digital influence operations during major elections, policymakers, scholars, and journalists have become increasingly interested in the political impact of social media ‘bots.’ Most recently, platform companies like Facebook and Twitter have been summoned to testify about bots as part of investigations into digitally-enabled foreign manipulation during the 2016 US Presidential election. Facing mounting pressure from both the public and from legislators, these companies have been instructed to crack down on apparently malicious bot accounts. But as this article demonstrates, since the earliest writings on bots in the 1990s, there has been substantial confusion as to exactly what a ‘bot’ is and what exactly a bot does. We argue that multiple forms of ambiguity are responsible for much of the complexity underlying contemporary bot-related policy, and that before successful policy interventions can be formulated, a more comprehensive understanding of bots — especially how they are defined and measured — will be needed. In this article, we provide a history and typology of different types of bots, provide clear guidelines to better categorize political automation and unpack the impact that it can have on contemporary technology policy, and outline the main challenges and ambiguities that will face both researchers and legislators concerned with bots in the future.

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1 Introduction

The same technologies that once promised to enhance democracy are now increasingly accused of undermining it. Social media services like Facebook and Twitter—once presented as liberation technologies predicated on global community and the open exchange of ideas—have recently proven themselves especially susceptible to various forms of political manipulation (Tucker et al. 2017). One of the leading mechanisms of this manipulation is the social media “bot,” which has become a nexus for some of the most pressing issues around algorithms, automation, and Internet policy (Woolley and Howard 2016). In 2016 alone, researchers documented how social media bots were used in the French elections to spread misinformation through the concerted MacronLeaks campaign (Ferrara 2017), to push hyper-partisan news during the Brexit referendum (Bastos and Mercea 2017), and to affect political conversation in the lead up to the 2016 US Presidential election (Bessi and Ferrara 2016). Recently, representatives from Facebook and Twitter were summoned to testify before Congress as part of investigations into digitally enabled foreign manipulation during the 2016 US Presidential election, and leading international newspapers have extensively covered the now-widely accepted threat posed by malicious bot accounts trying to covertly influence political processes around the world. Since then, a number of speculative solutions have been proposed for the so-called bot problem, many of which appear to rely on tenuous technical capacities at best, and others which threaten to significantly alter the rules governing online speech, and at worst, embolden censorship on the behalf of authoritarian and hybrid regimes. While the issues that we discuss in this article are complex, it has become clear that the technology policy decisions made by social media platforms as they pertain to automation, as in other areas (Gillespie 2015), can have a resounding impact on elections and politics at both the domestic and international level.

It is no surprise that various actors are therefore increasingly interested in influencing bot policy, including governments, corporations, and citizens. However, it appears that these stakeholders often continue to talk past each other, largely due to a lack of basic conceptual clarity. What exactly are bots? What do they do? Why do different academic communities understand bots quite differently? The goal of this article is to unpack some of these questions, and to discuss the key challenges faced by researchers and legislators when it comes to bot detection, research, and eventually, policy.
1.1 An Overview of Ambiguities

Reading about bots requires one to familiarize oneself with an incredible breadth of terminology, often used seemingly interchangeably by academics, journalists, and policymakers. These different terms include: robots, bots, chatbots, spam bots, social bots, political bots, botnets, sybils, and cyborgs, which are often used without precision to refer to everything from automated social media accounts, to recommender systems and web scrapers. Equally important to these discussions are terms like trolling, sock-puppets, troll farms, and astroturfing (Woolley 2016). According to some scholars, bots are responsible for significant proportions of online activity, are used to game algorithms and recommender systems (Yao et al. 2017), can stifle (Ferrara et al. 2016) or encourage (Savage, Monroy-Hernandez, and Hollerer 2015) political speech, and can play an important role in the circulation of hyperpartisan “fake news” (Shao et al. 2017). Bots have become a fact of life, and to state that bots manipulate voters online is now accepted as uncontroversial. But what exactly are bots?

Although it is now a commonly used term, the etymology of “bot” is complicated and ambiguous. During the early days of personal computing, the term was employed to refer to a variety of different software systems, such as daemons and scripts that communicated warning messages to human users (Leonard 1997). Other types of software, such as the early programs that deployed procedural writing to converse with a human user, were eventually referred to as “bots” or “chatbots.” In the 2000s, “bot” developed an entirely new series of associations in the network and information security literatures, where it was used to refer to computers compromised, co-opted, and remotely controlled by malware (Yang et al. 2014). These devices can be linked in a network (a “botnet”) and used to carry out distributed denial of service (DDoS) attacks (Moore and Anderson 2012). Once Twitter emerged as a major social network (and major home for automated accounts), some researchers began calling these automated accounts “bots,” while others, particularly computer scientists associated with the information security community, preferred the term “sybil”—a computer security term that refers to compromised actors or nodes within a network (Alvisi et al. 2013; Ferrara et al. 2016).

This cross-talk would not present such a pressing problem were not for the policymakers and pundits currently calling for platform companies to prevent foreign manipulation of social networks and to enact more stringent
bot policy (Glaser 2017). Researchers hoping to contribute to these policy
discussions have been hindered by a clear lack of conceptual clarity, akin
to the phenomenon known by social scientists as concept misformation or
category ambiguity (Sartori 1970). As Lazarsfeld and Barton (1957) once
argued, before we can investigate the presence or absence of some concept,
we need to know precisely what that concept is. In other words, we need to
better understand bots before we can really research and write about them.

In this article, we begin by outlining a typology of bots, covering early
uses of the term in the pre-World Wide Web era up to the recent increase
in bot-related scholarship. Through this typology, we then go on to demon-
strate three major sources of ambiguity in defining bots: (1) structure, which
concerns the substance, design, and operation of the “bot” system, as well
as whether these systems are algorithmically or human-based; (2) function,
which concerns how the “bot” system operates over social media, for example,
as a data scraper or an account emulating a human user and communicating
with other users; and (3) uses, which concerns the various ways that people
can use bots for personal, corporate, and political ends, where questions of
social impact are front and center. We conclude with a discussion of the ma-
jor challenges in advancing a general understanding of political bots, moving
forward. These challenges include access to data, bot detection methods,
and the general lack of conceptual clarity that scholars, journalists, and the
public have had to grapple with.

2 A Typology of Bots

In its simplest form, the word “bot” is derived from “robot.” Bots are have
been generally defined as automated agents that function on an online plat-
form (Franklin and Graesser 1996). As some put it, these are programs
that run continuously, formulate decisions, act upon those decisions with-
out human intervention, and are able adapt to the context they operate
in (Tsvetkova et al. 2017). However, since the rise of computing and the
eventual creation of the World Wide Web, there have been many different
programs that have all been called bots, including some that fulfill signifi-
cantly different functions and have different effects than those that we would
normally associate with bots today. One of the pioneering early works on
bots, Leonard’s *Origin of New Species* (1997), provides an excellent example
of the lack of clarity that the term had even as it first became widely used
in the 1990s. Various programs and scripts serving many different functions are all lumped into Leonard’s “bot kingdom,” such as web scrapers, crawlers, indexers, interactive chatbots that interact with users via a simple text interface, and the simple autonomous agents that played a role in early online “multi-user dungeon” (MUD) games. Each one of these types functions in different ways, and in recent years, has become associated with a different scholarly community. While a complete typology would be worthy of its own article, we provide here a brief overview of the major different processes and programs often referred to as “bots,” paying particular attention to those that are most relevant to current policy concerns.

2.1 ‘Web Robots’: Crawlers and Scrapers

As the Web grew rapidly following its inception in the 1990s, it became clear that both accessing and archiving the incredible number of webpages that were being added every day would be an extremely difficult task. Given the unfeasibility of using manual archiving tools in the long term, automated scripts—commonly referred to as robots or spiders—were deployed to download and index websites in bulk, and eventually became a key component of what are now known as search engines (Olston and Najork 2010; Pant, Srinivasan, and Menczer 2004).

While these crawlers did not interact directly with humans, and operated behind the scenes, they could still have a very real impact on end-users: it quickly became apparent that these scripts posed a technology policy issue, given that poorly executed crawlers could inadvertently overwhelm servers by querying too many pages at once, and because users and system administrators would not necessarily want all of their content indexed by search engines. To remedy these issues, the “Robot Exclusion Protocol” was developed by the Internet Engineering Task Force (IETF) to govern these “Web Robots” via a robots.txt file embedded in webpages, which provided rules for crawlers as to what should be considered off limits (Koster 1996). From their early days, these crawlers were often referred to as bots: for example, Polybot and IRLBot were two popular early examples (Olston and Najork 2010). Other terminology used occasionally for these web crawlers included “wanderers,” “worms,” “fish,” “walkers,” or “knowbots” (Gudivada et al. 1997).

Today, it has become common to begin writing on social media bots with big figures that demonstrate their apparent global impact. For example, re-
ports from private security and hosting companies have estimated that more than half of all web traffic is created by “bots,” and these numbers are occasionally cited by scholars in the field (Gilani, Farahbakhsh, and Crowcroft 2017). But a closer look indicates that the “bots” in question are in fact these kinds of web crawlers and other programs that perform crawling, indexing, and scraping functions. These are an infrastructural element of search engines and other features of the modern World Wide Web that do not directly interact with users on a social platform, and are therefore considerably different than automated social media accounts.

2.2 Chatbots

Chatbots are a form of human–computer dialog system that operate through natural language via text or speech (Deryugina 2010; Sansonnet, Leray, and Martin 2006). In other words, they are programs that approximate human speech and interact with humans directly through some sort of interface. Chatbots are almost as old as computers themselves: Joseph Weizenbaum’s program, ELIZA, which operated on an early time-shared computing system at MIT in the 1960s, impersonated a psychoanalyst by responding to simple text-based input from a list of pre-programmed phrases (Weizenbaum 1966).

Developers of functional chatbots seek to design programs that can sustain at least basic dialogue with a human user. This entails processing inputs (through natural language processing, for example), and making use of a corpus of data to formulate a response to this input (Deryugina 2010). Modern chatbots are substantially more sophisticated than their predecessors: today, chatbot programs have many commercial implementations, and are often known as virtual assistants or assisting conversational agents (Sansonnet, Leray, and Martin 2006), with current voice-based examples including Apple’s Siri and Amazon’s Alexa. Another implementation for chatbots is within messaging applications, and as instant messaging platforms have become extremely popular, text-based chatbots have been developed for multiple messaging apps, including Facebook Messenger, Skype, Slack, WeChat, and Telegram (Folstad and Brandtzaeg 2017). Bots have been built by developers to perform a range of practical functions on these apps, including answering frequently asked questions and performing organizational tasks. While some social media bots, like those on Twitter, can occasionally feature chatbot functionality that allows them to interact directly with human users (see, for instance, the infamous case of Microsoft’s “Tay” in Neff and
Nagy 2016), most chatbots remain functionally separate from typical social media bots.

2.3 Spambots

Spam has been a long-standing frustration for users of networked services, pre-dating the Internet on bulletin boards like USENET (Brunton 2013). As the early academic ARPANET opened up to the general public, commercial interests began to take advantage of the reach provided by the new medium to send out advertisements. Spamming activity escalated rapidly as the Web grew, to the point that spam was said to “threaten the Internet’s stability and reliability” (Weinstein 2003). As spam grew in scale, spammers wrote scripts to spread their messages at scale—enter the first “spambots.”

Spambots, as traditionally understood, are not simple scripts but rather computers or other networked devices compromised by malware and controlled by a third party (Brunton 2012). These have been traditionally termed “bots” in the information security literature (Moore and Anderson 2012). Machines can be harnessed into large networks (botnets), which can be used to send spam en masse or perform Distributed Denial of Service (DDoS) attacks. Major spam botnets, like Storm, Grum, or Rostock, can send billions of emails a day and are composed of hundreds of thousands of compromised computers (Rodríguez-Gómez et al. 2013). These are machines commandeered for a specific purpose, and not automated agents in the sense of a chatbot or social bot (see below).

Two other forms of spam that users often encounter on the web and on social networks are the “spambots” that post on online comment sections, and those that spread advertisements or malware on social media platforms. Hayati et al. (2009) study what they call “web spambots,” programs that are often application specific and designed to attack certain types of comment infrastructures, like the WordPress blogging tools that provide the back-end for many sites, or comment services like Disqus. These scripts function like a crawler, searching for sites that accept comments and then mass posting messages. Similar spam crawlers search the web to harvest emails for eventual spam emails (Hayati et al. 2009). These spambots are effectively crawlers and are distinct functionally from social bots. However, in a prime example of the ambiguity that these terms can have, once social networking services rose to prominence, spammers began to impersonate users with manually controlled or automated accounts, creating profiles on social networks and
trying to spread commercial or malicious content onto sites like MySpace (Lee, Eoff, and Caverlee 2011). These spambots are in fact distinct from the commonly discussed spambots (networks of compromised computers or web crawlers) and in some cases may only differ from contemporary social media bots in terms of their use.

2.4 Social Bots

As the new generation of “Web 2.0” social networks were established in the mid 2000s, bots became increasingly deployed on a host of new platforms. On Wikipedia, editing bots were deployed to help with the automated administration and editing of the rapidly growing crowdsourced encyclopedia (Geiger 2014, 342). The emergence of the microblogging service Twitter, founded in 2006, would lead to the large-scale proliferation of automated accounts, due to its open application programming interface (API) and policies that encouraged developers to creatively deploy automation through third party applications and tools. In the early 2010s, computer scientists began to note that these policies enabled a large population of automated accounts that could be used for malicious purposes, including spreading spam and malware links (Chu et al. 2010).

Since then, various forms of automation operating on social media platforms have been referred to as social bots. Two subtly different, yet important distinctions have emerged in the relevant social and computer science literatures, linked to two slightly different spellings: “socialbot” (one word) and “social bot” (two words). The first conference paper on socialbots” published in 2011, describes how automated accounts, assuming a fabricated identity, can infiltrate real networks of users and spread malicious links or advertisements (Boshmaf et al. 2011). These socialbots are defined in information security terms as an adversary, and often called “sybils,” a term derived from the network security literature for an actor that controls multiple false nodes within a network (Cao et al. 2012; Boshmaf et al. 2013; Mitter, Wagner, and Strohmaier 2014).

Social bots (two words) are a broader and more flexible concept, generally deployed by the social scientists that have developed a recent interest in various forms of automation on social media. A social bot is generally understood as a program “that automatically produces content and interacts with humans on social media” (Ferrara et al. 2016). As Stieglitz et al. (2017) note in a comprehensive literature review of social bots, this definition of-
ten includes a stipulation that social bots mimic human users. For example, Abokhodair et al. (2015, 840) define social bots as “automated social agents” that are public facing and that seem to act in ways that are not dissimilar to how a real human may act in an online space.

The major bot of interest of late is a subcategory of social bot: social bots that are deployed for political purposes, also known as political bots (Woolley and Howard 2016). One of the first political uses of social bots was during the 2010 Massachusetts Special Election in the United States, where a small network of automated accounts was used to launch a Twitter smear campaign against one of the candidates (Metaxas and Mustafaraj 2012). A more sophisticated effort was observed a year later in Russia, where activists took to Twitter to mobilize and discuss the Presidential election, only to be met with a concerted bot campaign designed to clog up hashtags and drown out political discussion (Thomas, Grier, and Paxson 2012). Since 2012, researchers have suggested that social bots have been used on Twitter to interfere with political mobilization in Syria (Abokhodair, Yoo, and McDonald 2015; Verkamp and Gupta 2013) and Mexico (Suárez-Serrato et al. 2016), with journalistic evidence of their use in multiple other countries (Woolley 2016). Most recently, scholars have been concerned about the application of political bots to important political events like referenda (Woolley and Howard 2016), with studies suggesting that there may have been substantial Twitter bot activity in the lead up to the UK’s 2016 Brexit referendum (Bastos and Mercea 2017), the 2017 French general election (Ferrara 2017), and the 2016 US Presidential Election (Bessi and Ferrara 2016). While social bots are now often associated with state-run disinformation campaigns, there are other automated accounts used to fulfill creative and accountability functions, including via activism (Savage, Monroy-Hernandez, and Hollerer 2015; Ford, Dubois, and Puschmann 2016) and journalism (Lokot & Diakopolous 2015). Social bots can be used for both benign commercial purposes as well as more fraught activities such as search engine optimization, spamming, and influencer marketing (Ratkiewicz et al. 2011).

2.5 Sockpuppets and ‘Trolls’

The term “sockpuppet” is another term that is often used to describe fake identities used to interact with ordinary users on social networks (Bu, Xia, and Wang 2013). The term generally implies manual control over accounts, but it is often used to include automated bot accounts as well (Bastos and
Sockpuppets can be deployed by government employees, regular users trying to influence discussions, or by “crowdturfers,” workers on gig-economy platforms like Fiverr hired to fabricate reviews and post fake comments about products (Lee, Webb, and Ge 2014).

Politically motivated sockpuppets, especially when coordinated by government proxies or interrelated actors, are often called “trolls.” Multiple reports have emerged detailing the activities of a legendary troll factory linked to the Russian government and located outside of St Petersburg, allegedly housing hundreds of paid bloggers who inundate social networks with pro-Russia content published under fabricated profiles (Chen 2015). This company, the so-called “Internet Research Agency,” has further increased its infamy due to Facebook and Twitter’s recent congressional testimony that the company purchased advertising targeted at American voters during the 2016 Presidential election (Stretch 2017). There are varying degrees of evidence for similar activity, confined mostly to the domestic context and carried out by government employees or proxies, with examples including countries like China, Turkey, Syria, and Ecuador (King et al. 2017; Cardullo 2015; Al-Rawi 2014; Freedom House 2016).

The concept of the “troll farm” is imprecise due to its differences from the practice of “trolling” as outlined by Internet scholars like Phillips (2015) and Coleman (2012). Also challenging are the differing cultural contexts and understandings of some of these terms. Country-specific work on digital politics has suggested that the lexicon for these terms can vary in different countries: for instance, in Polish, the terms “troll” and “bot” are generally seen as interchangeable, and used to indicate manipulation without regard to automation (Gorwa 2017). In the public discourse in the United States and United Kingdom around the 2016 US Election and about the Internet Research Agency, journalists and commentators tend to refer to Russian trolls and Russian bots interchangeably. Some have tried to get around these ambiguous terms: Bastos and Mercea (2017) use the term sockpuppet instead, noting that most automated accounts are in a sense sockpuppets, as they often impersonate users. But given that the notion of simulating the general behavior of a human user is inherent in the common definition of social bots (Maus 2017), we suggest that automated social media accounts be called social bots, and that the term sockpuppet be used (instead of the term troll) for accounts with manual curation and control.
2.6 Cyborgs and Hybrid Accounts

Amongst the most pressing challenges for researchers today are accounts which exhibit a combination of automation and of human curation, often called “cyborgs.” Chu et al. (2010, 21) provided one of the first, and most commonly implemented definitions of the social media cyborg as a “bot-assisted human or human-assisted bot.” However, it has never been clear exactly how much automation makes a human user a cyborg, or how much human intervention is needed to make a bot a cyborg, and indeed, cyborgs are very poorly understood in general. Is a user that makes use of the service Tweetdeck (which was acquired by Twitter in 2011, and is widely used) to schedule tweets or to tweet from multiple accounts simultaneously considered a cyborg? Should organizational accounts (from media organizations like the BBC, for example) which tweet automatically with occasional human oversight be considered bots or cyborgs?

Another ambiguity regarding hybrids is apparent in the emerging trend of users volunteering their real profiles to be automated for political purposes, as seen in the 2017 UK general election (Gorwa and Guilbeault 2017). Similarly, research has documented the prevalence of underpaid, human “clickworkers” hired to spread political messages and to like, upvote, and share content algorithms (Lee et al., 2011, 2014). Clickworkers offer a serviceable alternative to automated processes, while also exhibiting enough human-like behavior to avoid anti-spam filters and bot detection algorithms (Golumbia 2013). The conceptual distinction between social bots, cyborgs, and sock-puppets is unclear, as it depends on a theoretical and hereto undetermined threshold of automation. This lack of clarity has a real effect: problematically, the best current academic methods for Twitter bot detection are not able to accurately detect cyborg accounts, as any level of human engagement is enough to throw off machine-learning based models based on account features (Ferrara et al. 2016).

3 A Framework for Understanding Bots: Three Considerations

The preceding sections have outlined the multitude of different bots, and the challenges of trying to formulate static definitions. When creating a conceptual map or typology, should we lump together types of automation by their
use, or by how they work? Rather than attempting to create a definitive, prescriptive framework for the countless different types of bots, we recommend three core considerations that are useful when thinking about them, inspired by past work on developer–platform relations and APIs (Bogost & Montfort 2008). Importantly, these considerations are not framed as a rejection of pre-existing categorizations, and they account for the fact that bots are constantly changing and increasing in their sophistication. The framework has three parts, which can be framed as simple questions. The idea is that focusing on each consideration when assessing a type of bot will provide a more comprehensive sense of how to categorize the account, relative to one’s goals and purposes. The first question is structural: How does the technology actually work? The second is functional: What kind of operational capacities does the technology afford? The third is ethical: How are these technologies actually deployed, and what social impact do they have? We discuss these three considerations, and their implications for policy and research, below.

3.1 The Structure of the System

The first category concerns the substance, design, and operation of the system. There are many questions that need to be considered. What environment does it operate in? Does it operate on a social media platform? Which platform or platforms? How does the bot work? What type of code does it use? Is it a distinct script written by a programmer, or a publicly available tool for automation like If This Then That (IFTTT), or perhaps a type of content management software like SocialFlow or Buffer? Does it use the API, or does it use software designed to automate web-browsing by interacting with website html and simulating clicks (headless browsing)? Is it fully automated, or is it a hybrid account that keeps a “human in the loop”? What type of algorithm does it use? Is it strictly procedural (e.g. has a set number of responses, like ELIZA) or does it use machine learning to adapt to conversations and exhibit context sensitivity (Adams 2017)? Policy at both the industry and public level will need to be designed differently to target “bots” with different structural characteristics.

Perhaps the simplest and most important question about structure for bot regulation is whether the “bot” is made of software at all, or if it is a human exhibiting bot-like behavior. A surprising number of journalists and researchers describe human-controlled accounts as bots: for example, Munger’s (2017) online experiment where the so-called bot accounts were
manually controlled by the experimenter. Similarly, the recent media coverage of “Russian bots” often lumps together automated accounts and manually controlled ones under a single umbrella (Shane 2017). Even more ambiguous are hybrid accounts, where users can easily automate their activity using various types of publicly available software. At the structural level, technology policy will have to determine how this type of automation will be managed, and how these types of content management systems should be designed. The structure of the bot is also essential for targeting technical interventions, either in terms of automated detection and removal, or in terms of prevention via API policies. If policy makers are particularly concerned with bots that rely on API access to control and operate accounts, then lobbying social media companies to impose tighter constraints on their API could be an effective redress. Indeed, it appears as if most of the Twitter bots that can be purchased online or through digital marketing agencies are built to rely on the public API, so policy interventions at this level are likely to lead to a significant reduction in bot activity. Similarly, structural interventions would include a reshaping of how content management allows the use of multiple accounts to send duplicate messages and schedule groups of posts ahead of time.

3.2 The Bot’s Function

The second category pertains more specifically to what the bot does. Is the role of the bot to operate a social media account? Does it identify itself as a bot, or does it impersonate a human user, and if so, does it do so convincingly? Does it engage with users in conversation? Does it communicate with individual users, or does it engage in unidirectional mass-messaging?

Questions concerning function are essential for targeting policy to specific kinds of bots. They are also vital for avoiding much of the cross-talk that occurs in bot-related discourse. For instance, chatbots are occasionally confused with other types of social bots, even though both exhibit distinct functionalities, with different structural underpinnings. In their narrow, controlled environment, chatbots are often clearly identified as bots, and they can perform a range of commercial services such as making restaurant reservations or booking flights. Some chatbots have even been designed to build personal relationships with users—such as artificial companies and therapist bots (Floridi 2014; Folstad and Brandtzaeg 2017).

These new self-proclaimed bots pose their own issues and policy concerns,
such as the collection and marketing of sensitive personal data to advertisers (Neff and Nafus 2016). Importantly, chatbots differ substantially in both structure and function from most social bots, which communicate primarily over public posts that appear on social media pages. These latter bots are typically built to rely on hard-coded scripts that post predetermined messages, or that copy the messages of users in a predictable manner, such that they are incapable of participating in conversations. Questions about functionality allow us to distinguish social bots, generally construed, from other algorithms that may not fall under prospective bot-related policy interventions aimed at curbing political disinformation. If the capacity to communicate with users is definitive of the type of bot in question, where issues of deception and manipulation are key, then algorithms that do not have direct public interaction with users should not be considered to be conceptually similar; for example, web-scarpers.

3.3 The Bot’s Use

This third category specifically refers to how the bot is used, and what the end goal of the bot is. This is arguably the most important from a policy standpoint, as it contains ethical and normative judgements as to what positive, acceptable online behavior is—not just for bots, but also for users in general. Is the bot being used to fulfil a political or ideological purpose? Is it spreading a certain message or belief? If so, is its goal designed to empower certain communities or promote accountability and transparency? Or instead, does the bot appear to have a commercial agenda?

Because of the diversity of accounts that qualify as bots, automation policies cannot operate without normative assumptions about what kinds of bots should be allowed to operate over social media. The problem for the policymakers currently trying to make bots illegal (see, for example, the proposed “Bot Disclosure and Accountability Act, 2018,” also known as the Feinstein Bill) is that structurally, the same social bots can simultaneously enable a host of positive and negative actors. The affordances that make social bots a potentially powerful political organizing tool are the same ones that allow for their implementation by foreign governments (for example), much like social networks themselves, and other recent digital technologies with similar “dual-use” implications (Pearce 2015). Therefore, it is difficult to constrain negative uses without also curbing positive uses at the structural level.
For instance, if social media platforms were to ban bots of all kinds as a way of intervening on political social bots, this could prevent the use of various chatbot applications that users appreciate, such as automated personal assistants and customer service bots. Otherwise, any regulation on bots, either from within or outside of social media companies, would need to distinguish types of bots based on their function in order to formulate clear regulations to address the types of bots that have negative impact, while preserving the bots that are recognized as having a more positive impact. As specified by the topology above, it may be most useful to develop regulations to address social bots particularly, given that webcrapers are not designed to influence users through direct communicative activities, and chatbots are often provided by software companies to perform useful social functions.

The issue of distinguishing positive from negative uses of bots is especially complex when considering that social media companies often market themselves as platforms that foster free speech and political conversation. If organizations and celebrities are permitted certain types of automation—including those who use it to spread political content—then it seems fair that users should also be allowed to deploy bots that spread their own political beliefs. Savage et al. (2015), for instance, have designed a system of bots to help activists in Latin America mobilize against corruption. As political activity is a core part of social media, and some accounts are permitted automation, the creators of technology policy (most critically, the employees of social media platforms who work on policy matters) will be placed in the difficult position of outlining guidelines that do not arbitrarily disrupt legitimate cases, such as citizen-built bot systems, in their attempt to block illegitimate political bot activity, such as manipulative foreign influence operations. But it is clear that automation policies—like other content policies—should be made more transparent, or they will appear wholly arbitrary or even purposefully negligent. A recent example is provided by the widely covered account of ImpostorBuster, a Twitter bot built to combat antisemitism and hate speech, which was removed by Twitter, rather than the hate-speech bots and accounts it was trying to combat (Rosenberg 2017). While Twitter is not transparent as to why it removes certain accounts, it appears to have been automatically pulled down for structural reasons (such as violating the rate-limit set by Twitter, after having been flagged by users trying to take the bot down) without consideration of its normative use and possible social benefit.

Overall, it is increasingly evident that the communities empowered by
tools such as automation are not always the ones that the social media platforms may have initially envisioned when they hoped that users would use the tools—with the sophisticated use of bots, sock-puppets, and other mechanisms for social media manipulation by the US “alt-right” in the past two years providing an excellent example (Marwick and Lewis 2017). Should social media companies crack down on automated accounts? As platforms currently moderate what they consider to be acceptable bots, a range of possible abuses of power become apparent as soon as debates around disinformation and “fake news” become politicized. Now that government interests have entered the picture, the situation has become even more complex. Regimes around the world have already begun to label dissidents as “bots” or “trolls,” and dissenting speech as “fake news”—consider the recent efforts by the government of Vietnam to pressure Facebook to remove “false accounts” that have espoused anti-government views (Global Voices 2017). It is essential that social media companies become more transparent about how they define and enforce their content policies—and that they avoid defining bots in such a vague way that they can essentially remove any user account suspected of demonstrating politically undesirable behavior.

4 Current Challenges for Bot-Related Policy

Despite mounting concern about digital influence operations over social media, especially from foreign sources, there have yet to be any governmental policy interventions developed to more closely manage the political uses of social media bots. Facebook and Twitter have been called to testify to Congressional Intelligence Committees about bots and foreign influence during the 2016 US presidential election, and have been pressed to discuss proposed solutions for addressing the issue. Most recently, measures proposed by state legislators in California in April 2018, and at the federal level by Senator Diane Feinstein in June 2018, would require all bot accounts to be labeled as such by social media companies (Wang 2018). However, any initiatives suggested by policymakers and informed by research will have to deal with several pressing challenges: the conceptual ambiguity outlined in the preceding sections, as well as poor measurement and data access, lack of clarity about who exactly is responsible, and the overarching challenge of business incentives that are not predisposed towards resolving the aforementioned issues.
4.1 Measurement and Data Access

Bot detection is very difficult. It is not a widely reported fact that researchers are unable to fully represent the scale of the current issue by relying solely on data provided through public APIs. Even the social media companies themselves find bot detection a challenge, partially because of the massive scale on which they (and the bot operators) function. In a policy statement following its testimony to the Senate Intelligence Committee in November 2017, Twitter said it had suspended over 117,000 “malicious applications” in the previous four months alone, and was catching more than 450,000 suspicious logins per day (Twitter Policy 2017). Tracking the thousands of bot accounts created every day, when maintaining a totally open API, is virtually impossible. Similarly, Facebook has admitted that their platform is so large (with more than two billion users) that accurately classifying and measuring “inauthentic” accounts is a major challenge (Weedon, Nuland, and Stamos 2017). Taking this a step further by trying to link malicious activity to a specific actor (e.g. groups linked to a foreign government) is even more difficult, as IP addresses and other indicators can be easily spoofed by determined, careful operators.

For academics, who do not have access to more sensitive account information (such as IP addresses, sign-in emails, browser fingerprints), bot detection is even more difficult. Researchers cannot study bots on Facebook, due to the limitations of the publicly available API, and as a result, virtually all studies of bot activity have taken place on Twitter (with the notable exception of studies where researchers have themselves deployed bots that invade Facebook, posing a further set of ethical dilemmas, see Boshmaf et al. 2011). Many of the core ambiguities in bot detection stem from what can be termed the “ground truth” problem: even the most advanced current bot detection methods hinge on the successful identification of bot accounts by human coders (Subrahmanian et al. 2016), a problem given that humans are not particularly good at identifying bot accounts (Edwards et al. 2014). Researchers can never be 100 percent certain that an account is truly a bot, posing a challenge for machine learning models that use human-labeled training data (Davis et al. 2016). The precision and recall of academic bot detection methods, while constantly improving, is still seriously limited. Less is known about the detection methods deployed by the private sector and contracted by government agencies, but one can assume that they suffer from the same issues.
Just like researchers, governments have data access challenges. For example, what really was the scale of bot activity during the most recent elections in the United States, France, and Germany? The key information about media manipulation and possible challenges to electoral integrity is now squarely in the private domain, presenting difficulties for a public trying to understand the scope of a problem while being provided with only the most cursory information. The policy implications of these measurement challenges become very apparent in the context of the recent debate over a host of apparently Russian-linked pages spreading inflammatory political content during the 2016 US presidential election. While Facebook initially claimed that only a few million people saw advertisements that had been generated by these pages, researchers used Facebook’s own advertising tools to track the reach that these posts had generated, concluding that they had been seen more than a hundred million times (Albright 2017). However, Karpf (2017) and others suggested that these views could have been created by illegitimate automated accounts, and that there was no way of telling how many of the “impressions” were from actual Americans. It is currently impossible for researchers to either discount or confirm the extent that indicators such as likes and shares are being artificially inflated by false accounts, especially on a closed platform like Facebook. The existing research that has been conducted by academics into Twitter, while imperfect, has at least sought to understand what is becoming increasingly perceived as a serious public interest issue. However, Twitter has dismissed this work by stating that their API does not actually reflect what users see on the platform (in effect, playing the black box card). This argument takes the current problem of measurement a step further: detection methods which are already imperfect operate on the assumption that the Twitter Streaming APIs provide a fair account of content on the platform. To understand the scope and scale of the problem, policymakers will need more reliable indicators and better measurements than are currently available.

4.2 Responsibility

Most bot policy to date has in effect been entirely the purview of social media companies, who understandably are the primary actors in dealing with content on their platforms and manage automation based on their own policies. However, the events of the past year have demonstrated that these private (often rather opaque) policies can have serious political ramifications,
potentially placing them more squarely within the remit of regulatory and legal authorities. A key, and unresolved challenge for policy is the question of responsibility, and the inter-related questions of jurisdiction and authority. To what extent should social media companies be held responsible for the dealings of social bots? And who will hold these companies to account?

While the public debate around automated accounts is only nascent at best, it is clearly related to the current debates around the governance of political content and hyper-partisan “fake news.” In Germany, for instance, there has been substantial discussion around newly enacted hate-speech laws which impose significant fines against social media companies if they do not respond quickly enough to illegal content, terrorist material, or harassment (Tworek 2017). Through such measures, certain governments are keen to assert that they do have jurisdictional authority over the content to which their citizens are exposed. A whole spectrum of regulatory options under this umbrella exist, with some being particularly troubling. For example, some have argued that the answer to the “bot problem” is as simple as implementing and enforcing strict “real-name” policies on Twitter—and making these policies stricter for Facebook (Manjoo and Roose 2017). The recent emergence of bots into the public discourse has re-opened age old debates about anonymity and privacy online (boyd 2012; Hogan 2012), now with the added challenge of balancing the anonymity that can be abused by sock-puppets and automated fake accounts, and the anonymity that empowers activists and promotes free speech around the world.

In a sense, technology companies have already admitted at least some degree of responsibility for the current political impact of the misinformation ecosystem, within which bots play an important role (Shao et al. 2017). In a statement issued after Facebook published evidence of Russian-linked groups that had purchased political advertising through Facebook’s marketing tools, CEO Mark Zuckerberg mentioned that Facebook takes political activity seriously and was “working to ensure the integrity of the [then upcoming] German elections” (Read 2017). This kind of statement represents a significant acknowledgement of the political importance of social media platforms, despite their past insistence that they are neutral conduits of information rather than media companies or publishers (Napoli and Caplan 2017). It is entirely possible that Twitter’s policies on automation have an effect, no matter how minute, on elections around the world. Could they be held liable for these effects? At the time of writing, the case has been legislated in the court of public opinion, rather than through explicit policy interventions or
regulation, but policymakers (especially in Europe) have continued to put Twitter under serious pressure to provide an honest account of the extent that various elections and referenda (e.g. Brexit) have been influenced by “bots.” The matter is by no means settled, and will play an important part in the deeper public and scholarly conversation around key issues of platform responsibility, governance, and accountability (Gillespie 2018).

4.3 Contrasting Incentives

Underlying these challenges is a more fundamental question about the business models and incentives of social media companies. As Twitter has long encouraged automation by providing an open API with very permissive third-party application policies, automation drives a significant amount of traffic on their platform (Chu et al. 2010). Twitter allows accounts to easily deploy their own applications or use tools that automate their activity, which can be useful: accounts run by media organizations, for example, can automatically tweet every time a new article is published. Automated accounts appear to drive a significant portion of Twitter traffic (Gilani et al. 2017; Wojcik et al. 2018), and indeed, fulfill many creative, productive functions alongside their malicious ones. Unsurprisingly, Twitter naturally wishes to maintain the largest possible user base, and reports “monthly active users” to its shareholders, and as such, is loath to change its automation policies and require meaningful review for applications. It has taken immense public pressure for Twitter to finally start managing the developers who are allowed to build on the Twitter API, announcing a new “developer onboarding process” in January 2018 (Twitter Policy 2018).

As business incentives are critical in shaping content policy—and therefore policies concerning automation—for social media companies, slightly different incentives have yielded differing policies on automation and content. For example, while Twitter’s core concern has been to increase their traffic and to maintain as open a platform as possible (famously once claiming to be the “free speech wing of the free speech party”), Facebook has been battling invasive spam for years and has much tighter controls over its API. As such, it appears that Facebook has comparatively much lower numbers of automated users (both proportionally and absolutely), but, instead, is concerned primarily with manually controlled sock-puppet accounts, which can be set up by anyone and are difficult or impossible to detect if they do not coordinate at scale or draw too much attention (Weedon, Nuland, and Stamos 2020).
2017). For both companies, delineating between legitimate and illegitimate activity is a key challenge. Twitter would certainly prefer to be able to keep their legitimate and benign forms of automation (bots which regularly tweet the weather, for example) and only clamp down on malicious automation, but doing so is difficult, as the same structural features enable both types of activity. These incentives seem to inform the platforms’ unwillingness to share data with the public or with researchers, as well as their past lack of transparency. Evidence that demonstrated unequivocally the true number of automated accounts on Twitter, for example, could have major, adverse effects on their bottom line. Similarly, Facebook faced public backlash after a series of partnerships with academics that yielded unethical experiments (Grimmelmann 2015). Why face another public relations crisis if they can avoid it?

This illustrates the challenge that lies behind all the other issues we have mentioned here: platform interests often clash with the preferences of the academic research community and of the public. Academics strive to open the black box and better understand the role that bots play in public debate and information diffusion, while pushing for greater transparency and more access to the relevant data, with little concern for the business dealings of a social networking platform. Public commentators may wish for platforms to take a more active stance against automated or manually orchestrated campaigns of hate speech and harassment, and may be concerned by the democratic implications of certain malicious actors invisibly using social media, without necessarily worrying about how exactly platforms could prevent such activity, or the implications of major interventions (e.g. invasive identity-verification measures). There are no easy solutions to these challenges, given the complex trade-offs and differing stakeholder incentives at play.

While scholars strive to unpack the architectures of contemporary media manipulation, and legislators seek to understand the impact of social media on elections and political processes, the corporate actors involved will naturally weigh disclosures against their bottom line and reputations. For this reason, the contemporary debates about information quality, disinformation, and “fake news”—within which lie the questions of automation and content policy discussed in this article—cannot exist separately from the broader debates about technology policy and governance. Of the policy and research challenges discussed in this last section, this is the most difficult issue moving forward: conceptual ambiguity can be reduced by diligent scholarship, and researchers can work to improve detection models, but business incentives
will not shift on their own. As a highly political, topical, and important technology policy issue, the question of political automation raises a number of fundamental questions about platform responsibility and governance that have yet to be fully explored by scholars.

5 Conclusion

Amidst immense public pressure, policymakers are trying to understand how to respond to the apparent manipulation of the emerging architectures of digitally enabled political influence. Admittedly, the debate around bots and other forms of political automation is only in its embryonic stages; however, we predict that it will be a far more central component of future debates around the political implications of social media, political polarization, and the effects of “fake news,” hoaxes, and misinformation. For this to happen, however, far more work will be needed to unpack the conceptual mishmash of the current bot landscape. A brief review of the relevant scholarship shows that the notion of what exactly a “bot” is remains vague and ill-defined. Given the obvious technology policy challenges that these ambiguities present, we hope that others will expand on the basic framework presented here and continue the work through definitions, typologies, and conceptual mapping exercises.

Quantitative studies have recently made notable progress in the ability to identify and measure bot influence on the diffusion of political messages, providing promising directions for future work (Vosoughi et al. 2018). However, we expect that to maximize the benefits of these studies for developing policy, their methods and results need to be coupled with a clearer theoretical foundation and understanding of the types of bots being measured and analyzed. Although the relevant literature has expanded significantly in the past two years, there has been little of the definitional debate and the theoretical work one would expect: much of the recent theoretical and ethnographic work on bots is not in conversation with current quantitative efforts to measure bots and their impact. As a result, qualitative and quantitative approaches to bot research have yet to establish a common typology for interpreting the outputs of these research communities, thereby requiring policymakers to undergo unwieldy synthetic work in defining bots and their impact in their effort to pursue evidence-based policy. As a translational effort between quantitative and qualitative research, the typology developed
in this article aims to provide a framework for facilitating the cumulative
development of shared concepts and measurements regarding bots, media
manipulation, and political automation more generally, with the ultimate
goal of providing clearer guidance in the development of bot policy.

Beyond the conceptual ambiguities discussed in this article, there are sev-
eral other challenges that face the researchers, policymakers, and journalists
trying to understand and accurately engage with politically relevant forms of
online automation moving forward. These, most pressingly, include imper-
fect bot detection methods and an overall lack of reliable data. Future work
will be required to engage deeply with the question of what can be done to
overcome these challenges of poor measurement, data access, and—perhaps
most importantly—the intricate layers of overlapping public, corporate, and
government interests that define this issue area.

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