Bots as Virtual Confederates: Design and Ethics

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ABSTRACT
The use of bots as virtual confederates in online field experiments holds extreme promise as a new methodological tool in computational social science. However, this potential tool comes with inherent ethical challenges. Informed consent can be difficult to obtain in many cases, and the use of confederates necessarily implies the use of deception. In this work we outline a design space for bots as virtual confederates, and we propose a set of guidelines for meeting the status quo for ethical experimentation. We draw upon examples from prior work in the CSCW community and the broader social science literature for illustration. While a handful of prior researchers have used bots in online experimentation, our work is meant to inspire future work in this area and raise awareness of the associated ethical issues.

INTRODUCTION
Randomized experiments provide the gold standard for evidence of causality in the behavioral sciences. Yet many questions in social science are difficult to study experimentally. The use of randomized trials to study human social behavior requires situating human subjects in settings where the attributes and behavior of co-present individuals are controlled.

Traditionally, social psychologists and sociologists have often addressed this problem through the use of “confederates” who are trained by the researcher to follow pre-assigned scripts. For example, Solomon Asch, one of the pioneers in the use of confederates in social psychology, tested conformity by exposing participants to incorrect perceptual judgments of other group members, all of whom were confederates [2]. Stanley Milgram, Asch’s student, used confederates in a field experiment by having them stand on the sidewalk and direct their gaze upwards towards a tall building.

Bots are digital agents who act according to tailored algorithms, often as peers, in online spaces such as online social networks or chatrooms. Bots are increasingly prevalent in commercial and hobbyist applications, but are also beginning to make appearances in the academic literature as tools for scientific experimentation. For instance, several groups of researchers have used bots to test which attributes and activity patterns lead to greater numbers of followers on Twitter and other online social networks [1, 26, 13]. Others have proposed using Twitter bots to bridge polarized communities and pop filter bubbles [14]. Within the CSCW community, researchers recently used bots to test which social media strategies might be most effective at mobilizing volunteer activists [34]. Still, the use of bots for scientific experimentation has promise that potentially extends far beyond this handful of existing cases.

Bots allow for fine-grained control and high degrees of research replicability and transparency (via the publication of bot source code). Demographic attributes, personalities, and normative behaviors can be randomly assigned to bots. Since bot behavior is completely automated, bots can also be used for large-scale and longitudinal social experimentation in which a large number of confederates must engage with participants for a long period of time.

CSCW and the surrounding communities are likely to use confedabots in the future due to the existing expertise in the necessary areas and due to the need for this technique. Prior work could have potentially been strengthened by using bots for causal inference. Researchers have used observational analysis to study the predictors of following behavior on Twitter [17]. Bots could be used to test the causality of these findings [26, 13]. Other recent work has examined why people make particular choices in Doodle polls [38]. Similar studies could be conducted using bots to manipulate the popularity of time slots in order to remove confounds in the natural experiment the prior research analyzed. Researchers are also interested in how people respond to requests for help on social media. A recent study identifying differences in

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how people respond to these requests versus other types of social media posts could have also been complemented by bots making these different requests [22].

Alongside these largely unexplored potential applications of bots as virtual confederates, however, there are ethical challenges. Although not specifically related to bots as virtual confederates, major public outcries against two online field experiments have already occurred due to the violation of public expectations about researcher behavior. When Facebook published the results of their notorious “emotional contagion” experiment in 2014 [19], a bustle of negative attention ensued. One common complaint was that Facebook had not sought informed consent. Another issue was the possibility of harm stemming from the researchers’ attempts to manipulate users’ emotions. A second scandal occurred when Microsoft Research released a Twitter bot called “Tay” that interacted with users on Twitter and learned from those interactions. Due to its learning algorithm and the content it was exposed to, Tay ultimately began posting disturbing and offensive content.

Our goals in this paper are to outline a potential design space for future confedabot experiments, and to discuss ways to avoid ethical issues with these types of experiments. The design space we propose is grounded in the existing work that has used bots, but we hope to also expose the substantially broader possibilities of this technique. A number of previous authors have discussed the ethics of online experimentation, but none have addressed the challenges associated with bots and how to overcome them. After outlining our design space for bots as virtual confederates, we draw upon extensive prior exploration of the ethics of related experimental techniques in order to explicate the major ethical concerns with using bots as virtual confederates in online field experiments. We use precedent set by existing practices and community norms in order to propose guidelines for how to design ethical field experimentation involving confedabots.

BACKGROUND

Online Field Experiments

Online field experiments consist of randomized trials conducted on websites or other networked digital platforms such as Facebook, Twitter, or LinkedIn. One of the first high-profile massive online field experiments implemented a system on Facebook that encouraged U.S. users to vote in a general election [6]. The research found that showing users pictures of their friends who had voted was far more effective in promoting voter turnout than a message from Facebook reminding users to vote. However, this experiment did not involve bots.

Virtual Confederates

Virtual confederates are artificial agents who act like human confederates in an experimental context. The concept of a virtual confederate has been explored previously in laboratory settings [5], but not in field experiment settings. The use of virtual confederates in online field experiments presents challenges not faced in the lab.

Bots

A bot is an algorithm that automatically generates user content and interactions in an online space. Many online spaces are already populated by bots. For example, at least 10% of Twitter users are thought to be bots of one kind or another.¹ Many of these bots are used by companies or other organizations for direct advertisement, search engine optimization, or other promotional purposes. Others of these bots are interesting, creative, and highly valued by the community. For example, @congressedits is a Twitter bot that monitors wikipedia for edits made by IP addresses that can be traced to members of the U.S. Congress.

Internet Ethics

The ethics of internet research continues to be an area of sustained interest in the CSCW community [12, 11, 18] and beyond [20, 7, 33]. As anticipated by the foundational literature in this area [24], the techniques of internet research continue to evolve, and we must continue the conversation around the ethics of those techniques. To the best of our knowledge, there have been no investigations yet into the ethics of bots as virtual confederates for online field experiments.

BOTS AS VIRTUAL CONFEDERATES

In this section we provide a scheme for conceptualizing confedabot experiments. We outline four categories of online field experiments that could be conducted using bots: varying actions, varying attributes, varying algorithms, and creating artificial social contexts.

Intervening on Actions

The simplest kind of experiment to do with a bot is to randomize individual actions to identify the effects of those actions. These interventions can either be isolated, so that the only purpose of the bot is to execute these actions, or these randomized interventions can be embedded within the regular behavior of the bot.

Example

A simple example of such a bot is one that implements a richer-richer field experiment. A number of researchers have studied how incrementing the popularity of items in online systems can lead to gains in future popularity (e.g., [28, 36]). A bot implementing such an experiment would look for random pieces of content to upvote, for example on a site like reddit.

Another example of this type of experiment is one where a subset of the bot’s actions form the experiment itself, and the rest of the actions form an identity for the bot. Aside from the fact that the bots were not pretending to be humans, a good example of this type of experiment is the prior work examining which volunteer recruitment strategies are most useful for Twitter bots [34]. These researchers created bots who would follow a simple workflow to attract volunteers, and the wording of their initial message to potential volunteers was randomized across four types.

Intervening on Attributes
A second type of experiment is to intervene on an attribute of a bot that doesn’t actually affect the bot’s behavior. In this case, the algorithm generating the bot’s actions is a unit of control, and the experiment is layered on top of the algorithm generating that content.

Example
A prime example of intervening on attributes is a minimal version of the type of bots used in prior work to reverse engineer the techniques used by popular Twitter bots to gain followers [13]. A minimal version of this Twitter bot would always tweet random content (e.g., quotes from other users or content generated from an n-gram language model), but some attribute of the account, such as the presented gender of the bot, would be randomized.

Intervening on Algorithms
A third type of experiment is to intervene on the entire behavioral profile of a bot. In this case, the effect of a particular behavioral profile as embodied in the bot’s algorithm is tested.

Example
An example of this sort of bot would be a different minimal version of the type of bots used in prior work to reverse engineer popular Twitter bots [13]. This minimal Twitter bot would again always tweet random content, but would do so at either a high rate or a low rate. This experiment tests the effect of activity rate on following behavior. Another example would be to vary the type of content that the bot tweets about, or the personality of the bot.

Artificial Contexts
A final type of experiment consists of the creation of an artificial context where multiple bots are used together in order to create a rich social scenario.

Example
One potential example would be to create a forum thread for the purposes of an experiment, and populate it initially with multiple bots who interact with each other in that thread.

BASIC ETHICAL ISSUES
In the United States, the Belmont Report is the canonical document that lays out the basic guidelines for ethical experimentation in the behavioral sciences. The Belmont Report centers around three principles: respect for persons, beneficence, and justice. Following these three principles ensures that the personal autonomy of participants is not violated, that the benefits of a study outweigh its risk, and that the benefits and risks are distributed fairly among the participant population. These principles have been codified in policy within the United States in what is called the “Common Rule”. In this section we outline how the principles described in the Belmont Report, as codified in the Common Rule, come to bear on the major ethical issues involved in using bots as virtual confederates in online field experiments. By and large, we are able to focus our discussion around these foundational principles because most modern ethical guidelines for experimentation closely mirror the principles outlined in the Belmont Report. Nonetheless, there is substantial disciplinary variation in how conservatively these principles are interpreted and in how they are enforced. Where there is notable disciplinary variation as it concerns bots as confederates, we will add discussion.

Informed Consent
The ethical principle of respect for persons implies that researchers must obtain informed consent in human experimentation—experimenting on participants without informed consent necessarily entails the intention to violate those participants’ personal autonomy. Unfortunately informed consent can be difficult or impossible to obtain in many online field experiments, especially those conducted as a peer in an online system. The content a bot creates is likely publicly available, and thus the researcher cannot control who gets to see that content. Even in settings where the researcher can control information flow, asking users via direct messages for permission to expose them to the experiment might be more intrusive than conducting the experiment itself.

Perspectives differ on whether there can be exceptions to the requirement that informed consent be obtained. Recent work investigating the ethical practices of CSCW researchers found that 22% of researchers surveyed held the view that obtaining informed consent is always necessary [37]. At the same time, waivers of informed consent are sought and obtained in field experiments across the social sciences [23, 9]. However, the omission of informed consent was one of the key controversial issues discussed in the turmoil surrounding Facebook’s emotional contagion experiment.

Practically speaking, many confedabot experiments will only be possible if the requirement for informed consent is waived. The Common Rule provides explicit guidelines on when such a waiver may be permissible: when the risks of an experiment are extremely low and obtaining informed consent is difficult. Omitting informed consent in an experiment that uses bots as virtual confederates must therefore clearly pose minimal risk. In developing our guidelines for the viable use of confedabots, this consideration will be paramount.

Deception
Strictly interpreted, the principle of respect for persons prohibits most forms of deception in behavioral experimentation, unless a participant has consented to being deceived. Deception is problematic because it is used with the expectation that participants would behave differently were they not deceived. Deception therefore intentionally circumvents individual autonomy.

Unfortunately, the use of confedabots is likely to entail some degree of deception. Predominantly, for the conclusions gleaned from experiments using confedabots to be compelling, the researcher may hope that people think the confedabots are actually human users. Explicit deception is also a possibility. Bots that spread misinformation about facts or world events could be considered unethical. More subtle grey cases can also occur. Even if a bot is not explicitly spreading false information about the world, the actions or words of a bot might still be able to viewed as explicitly deceptive.
if the bot references its internal mental states. In an extreme example, a confedabot expressing love for a person appears intuitively unethical. In this case we do not believe the bot actually has the internal feeling of love, and hence the bot is lying about loving the person. In less extreme cases, if a bot copies the tweets of a human, and that human expresses certain internal feelings or references particular personal life events, the bot would be lying again. Even in the banal case of a bot that simply upvotes random content, that bot is being deceptive about its judgements of what it likes since the bot has no internal preferences about what to upvote.

Perspectives differ widely across fields on the ethics of using deception in behavioral experimentation. In the field of psychology, deception is considered permissible, but the relative benefits of deception must justify its use, and participants must eventually be told that they were deceived [3]. In economics, the use of deception is generally forbidden. Interestingly, the main reason that economists frown upon deception is not directly out of ethical considerations for the participants, but rather out of concern for the effect that the use of deception might ultimately have on the validity of behavioral experiments. One of the main concerns is maintaining trust within the participant population [10]. The concern is that experiments involving deception may adversely affect how participants behave not only in the deceitful experiments but also in those that do not involve deception, because participants will always expect they are being tricked. In principle, this justification would seem to exclude any form of deception. In practice, however, there is a meaningful difference between explicit deception versus deception by omission [21]. Surveys by economists of researchers and participants show that explicit deception is thought of as being less acceptable than deception by omission [21, 32]. Furthermore, deception by omission has been used in a number of relatively recent influential field experiments in economics [4, 8, 31].

There is documented disagreement among CSCW researchers on the use of deception. Researchers in communications tend to feel more comfortable with the use of deception than information scientists or computer scientists [37]. A conservative reading of the ACM Code of Ethics, the canonical ethics document for researchers in computer science, forbids the use of deception. ACM charges their members to “be honest and trustworthy” as a moral imperative. The explicit guidelines associated with this imperative are mostly targeted at engineers who build products, apparently to be honest and trustworthy towards their customers, but the principle itself could easily be interpreted more broadly.

In terms of the views of the public at large, one case of early work studying how bots can become popular found that some people on the site being studied were unhappy when they discovered a bot had become so influential [1]. The bot was banned by site administrators, users expressed discomfort at the unfamiliar account frequently visiting their profiles, and users expressed concern of privacy violation.

Given the complexities involved in these different forms of possible deception, and the lack of a consensus for what types of deception are permissible, we recommend the Association of Internet Researchers’ (AoIR) case-by-case approach of benefit-harm analysis [24] in analyzing what amount of deception is permissible. In many cases, it may also be possible to announce the use of deception on the bot profile at the conclusion of the experiment to satisfy the need for debriefing experiment participants.

**Direct Harm**

The possibility of direct harm to participants also forms an ethical challenge. Given the breadth of behavior that bots can exhibit, there are many ways that bots could cause harm, and generating an exhaustive list is impractical. A few potential sources that are likely to commonly arise are exposure to explicit or disturbing content, direct manipulation of behavior in a negative way, violation of trust, and inconvenience or annoyance. Care must be taken in experimental design in order to avoid these and other potential sources of direct harm.

**Terms of Service**

Terms of service may too pose a potential ethical question for research involving bots. Certain websites, such as Twitter, allow account automation for certain purposes, but other sites do not. Facebook’s terms of service forbids accessing the site through automated means without prior permission, and Yik Yak forbids automated access altogether. The key question in these cases is whether it is unethical to violate the site’s terms of service in order to conduct a scientific experiment.

There is significant controversy regarding this question [37]. The ACM Code of Ethics states that “violations of the terms of a license agreement are contrary to professional behavior”, and these violations may even be considered illegal under the Computer Fraud and Abuse Act [35]. At the same time, researchers have challenged this guidance on the grounds that some types of important research (e.g., in algorithmic accountability) are impossible without violating terms of service. In the United States, violating terms of service was ruled as non-criminal [16].

In light of these conflicting perspectives, we recommend following terms of service unless the research question absolutely cannot be answered without violating them, and only if the benefits of the study outweigh the risks of this harm. The intention to violate terms of service should also be approved by the researcher’s Institutional Review Board (IRB).

**Context Dependence**

A final ethical challenge is context dependence. Ethical considerations always vary from case to case, and context is especially important in reasoning about internet ethics [30]. Unlike laboratory experiments, where the context of an experiment is relatively easy to control, the context of field experiments varies greatly from one to the next. A confedabot experiment on Twitter may be received quite differently from

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1. [https://www.yikyak.com/terms](https://www.yikyak.com/terms)
2. [https://support.twitter.com/articles/76915](https://support.twitter.com/articles/76915)
3. [https://www.facebook.com/terms](https://www.facebook.com/terms)
4. [https://www.yikyak.com/terms](https://www.yikyak.com/terms)
analogous experiment conducted on reddit due to the differing norms on these sites, or the differing expectations that users have about each other.

One important consideration in deciding whether to conduct an experiment involving confedabots on a particular website is the current presence or absence of bots on the site. Some online communities, such as Wikipedia and Twitter, have norms that are relatively welcoming to the presence of bots. In other communities, such as Facebook or Yik Yak, the presence of a bot may be unusual. In order to avoid violating the expectations or trust of a website’s users, and simply to avoid annoying them, it is important to observe whether bots are already present on that site and to observe how those bots typically participate in that space. Contingency on context is especially important in evaluating whether to use deception. In an environment where there are no bots, or where honesty and integrity in the community is held as a standard for participation, deception may be less justifiable.

Further complicating matters, many large websites also have a diverse enough user base that there may be multiple communities with highly disparate norms within the site. For example, psychological responses are known to vary widely between cultures [15]. These cultural differences may play an important role in the ethics of online experimentation, and should be understood better. Anecdotal evidence in prior work suggests that there may be cultural variation in receptivity to bots [34].

Other contextual factors include the nature of the interactions involved in the experiment at hand. In a real example from early internet research, a support group website’s users grew upset when they learned researchers were watching them [20]. In other cases, the research context might put participants at a higher risk of harm, such as an experiment mediating between abusive individuals and victims [25].

There is little controversy that risks should be carefully considered in deploying any system, and context is an important part of that process. The ACM Code of Ethics charges us to “give comprehensive and thorough evaluations of computer systems and their impacts, including analysis of possible risks”. The AoIR states “ethical decision-making is best approached through the application of practical judgment attentive to the specific context.”

To meet this challenge, we suggest carefully researching the norms of user behavior on whatever site is being used to conduct a confedabot experiment. In the style of the AoIR’s guidelines, some useful questions to ask are: “Do bots exist already on this site?” “Do other users of the site know that bots exist?” “What are typical behaviors of the users?” “What are typical behaviors of the bots?” “Who are the users that are most likely to be interacting with the bots involved in this research?” “Are those users more or less likely to be upset that they are interacting with bots?”

PROPOSED GUIDELINES

We now propose a set of conservative guidelines for meeting the status quo for ethical behavioral experimentation motivated by the issues we have discussed. Given that informed consent is likely to be difficult to obtain in confedabot experiments, the main principle behind these guidelines is achieving minimal risk as defined in the Common Rule. In brief, the guidelines we suggest are:

1. **Ordinary Behavior:** The use of a confedabot should not expose people to anything they would not be exposed to anyway. In particular,
   (a) A confedabot should only be used in communities where bots are already present.
   (b) The actions and attributes of a confedabot should not be unusual.

2. **Harm Reduction:** Efforts should be made to ensure a confedabot does not cause direct harm.

3. **Careful Evaluation:** The potential impact and potential harm from using confedabots should be carefully evaluated in the context of the site of the proposed research.

**Ordinary Behavior**

The Common Rule defines minimal risk as meaning “the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life”. To comply, bots should not alter the overall experiences of other users on the site of the experiment. If bots are not already present on a site, then creating confedabots on that site risks exposing people to bots for the first time in that environment. Therefore confebots are most appropriately used on sites that already have a noticeable bot presence. We also recommend avoiding unusual behavior, such as inordinately high levels of activity or directly messaging random strangers, since these behaviors could also alter users experiences. We therefore propose as a guideline that confedabots should act like “ordinary users” on sites that already have bots.

**Example**

One example of a confedabot that conforms to this guideline is a bot that upvotes random content on reddit. To meet the guideline, this experiment should only be conducted in subreddits where bots are used. Since upvoting occurs frequently on reddit, this simple bot is not performing any unusual actions, especially if the number of upvotes is only a small number per hour.

**Harm Reduction**

We recommend implementing infrastructure that reduces the potential direct harm a confedabot could cause. Even if a bot’s behavior is ordinary on a particular site, many actions that might be normal on that site could still be considered harmful. For instance, verbal abuse and harassment are common in certain online contexts [25]. Methods such as persistently targeting particular users should probably be avoided. Mechanisms such as keyword filters and curated content libraries should be put in place to avoid posting disturbing or offensive content. Explicit deception, including misrepresenting facts or being unduly personal, is most safe to avoid. A form of harm reduction for interventions in especially sensitive research areas is semi-automation. In this case the bot
would have partial human supervision so that human judgement could play a role in deciding when a particular intervention might be too risky.

Example

One example of a failure to meet this guideline is Microsoft’s Tay bot. Few details are available about how Tay was implemented, but from the bot’s behavior, it appears that minimal precautions were taken to avoid posting disturbing content. Much of the most extreme behavior Tay exhibited could have likely been avoided using keyword-based content filters.

An example of semi-automation for harm reduction is a recent experiment in which researchers varied race and status attributes of Twitter accounts and observed how these characteristics affected response to censure for the offensive use of racial slurs [29]. The experiment arguably did not use bots since the Twitter accounts were not autonomously controlled, but the experiment did involve automation for detecting users to target in the experiment, and also integrated human supervision of the subject population, for example to help ensure that minors were not targeted.

Careful Evaluation

Our final recommendation is that the costs and benefits of using confedabots should be carefully evaluated. The particulars of the proposed experimental design and the context of the site of the proposed experiment should be carefully considered in these evaluations. In the words of the AoIR [24]:

> Ethical decision-making is a deliberative process, and researchers should consult as many people and resources as possible in this process, including fellow researchers, people participating in or familiar with contexts/sites being studied, research review boards, ethics guidelines, published scholarship (within ones discipline but also in other disciplines), and, where applicable, legal precedent.

As a component of these considerations, if it is possible to perform the experiment in a way that allows for informed consent or a more laboratory-like online setting, then that route should be explored, and existing guidelines (e.g., [20]) should be employed. For example, if a website is designed specifically for the purposes of the experiment, or if the researcher has a collaboration with the owners of the website that is used for the experiment at hand, blanket opt-in decisions may be possible for users of the website.

Example

One exemplar of all the above guidelines is the recent work on “botivists” that explored the best social media strategies to use for recruiting volunteer activists [34]. The experiment was conducted on Twitter, where bots are already common, and the actions of the bot were not unusual (e.g., they did not make an inordinate number of posts or disrupt existing discussions or make outrageous requests). The authors also took great care to avoid harm, such as in refraining from following up with users who never interacted with their bots. Finally, the authors were thoughtful in their assessment of the harms and benefits of their experiment. For example, the authors were cognizant of the unanticipated distress that the bots caused to some of the activist community members.

DISCUSSION AND CONCLUSIONS

Our main goals in this paper were to articulate the methodology of bots as virtual confederates for online field experiments, to outline a design space for “confedabots”, and to anticipate and preemptively address the ethical issues that arise with conducting this type of experiment. Our hope is that this discussion will encourage and advance experimental work using this methodology.

Significant gaps remain in this initial exploration of the ethics of confedabots. Our guidelines were targeted at meeting the current conditions for ethical experimentation. This approach is likely enough for approval from an IRB or its equivalent but does not provide us with a way to meet the strictest criteria outlined by the Belmont Report. In particular current standards are heavily weighted towards a utilitarian comparison of risk and harm, where a small probability of harm is justifiable and minor violations of personal autonomy can be permissible. The extent to which these transgressions cause actual harm is an open question. For instance it is unknown the extent to which online field experiments conducted without informed consent might surprise or offend online users. Even if the experiment has no potential harm to participants, there is still the possibility that people will react negatively to the use of experimentation in their online community. The Facebook emotional contagion experiment controversy suggests that some users might react negatively to any experiment, no matter how many precautions have been taken. At the same time, an aspect of that backlash might have been that Facebook was directly involved in the experiment. Perhaps confedabots would be treated as more permissible in cases when they are implemented by peers on the system.

Another question is the extent to which the public at large understands the pervasiveness of bots in online spaces. Our guidelines suggest limiting confedabots to sites where bots are pervasive already. A stricter guideline would only allow bots where people are actually aware of the presence of those bots. How to most effectively evaluate the relevant norms on a website in order to minimize harm is also unclear. Shifts in public perceptions on these issues may also occur over time, and tracking these changes presents a further challenge.

Ethical concerns regarding the use of confedabots point to a broader need for future efforts to elaborate ethical guidelines for online experimentation. A possible strategy would be to create a system for maintaining an open public dialogue about social science and the importance of experimentation. Such a system could mitigate the most serious potential risks of omitting informed consent and using deception. On the scientific and methodological side, future work could instantiate or expand the design space we have proposed.

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