

# Intentional Weakening of Encryption: The Ethical Implications of Apple's Refusal to Create a "Backdoor"

Daniel Wong

Computer Science

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## Abstract

In December of 2015, two attackers killed 14 people in San Bernardino, California. The attackers destroyed their personal phones but their work iPhones were recovered by the FBI. However, the iPhone required a 4 digit pin to unlock it. The FBI requested data from Apple through valid subpoenas and search warrants. Then, the FBI requested Apple to engineer a version of the iPhone's operating system that would allow it to disable security features once installed. Apple declined this request stating that in the wrong hands, this software can have the potential to unlock any iPhone in someone's physical possession. Was it ethical for Apple to refuse the FBI's request to create a "backdoor" to all iPhones? [?]

The United States government urged Apple to comply with the order after being opposed. The FBI stated they would allow Apple to destroy the software once the FBI was able to unlock and remove security features of the attacker's iPhone. Critics argued that Apple and technology companies alike should be held to the same provisions which made cellular encryption weak enough to allow officials to "tap" phone conversations as seen with A5/1. Others argue in defense of Apple stating that the intentional weakening of encryption will lead to easy access of the encrypted data. After A5/1 was used to encrypt phone conversations, security researchers were able to attack and easily decrypt the conversations.

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# 1 FACTS

In December 2015, Syed Rizwan Farook and another attacker killed 14 people and seriously injured 22 others. After the attackers died, the FBI was able to recover Farook's work phone. The FBI had the National Security Agency attempt to unlock the phone. However, after a limited amount of incorrect attempts, the phone would automatically delete all of its data. With the NSA's absence of knowledge required to unlock the phone, the FBI turned to Apple and issued valid warrants and subpoenas. Apple complied and gave all of the data and information available to them.[?]

The FBI needs Apple's help because the security settings on the iPhone lock may erase all of the phone's data if passwords are entered incorrectly too many times. The FBI requested Apple to engineer an operating system that could be installed onto the attacker's phone to disable critical safety features. This operating system would allow the FBI as many trials to break the 4 digit pin without compromising the phone's encrypted data. [?]

Apple refused the FBI's orders to create an operating system that would circumvent several important security features and to install the operating system on the iPhone recovered during the investigation of the San Bernardino case. Apple believes that building this operating system would create a backdoor and while the government may argue that its use would be limited to this case, there is no way to guarantee such control. [?]

In Apple's letter to their customers, they explain that the "key" to an encrypted system is a piece of information that unlocks the data, and it is only as secure as the protections around it. Once the information is known, or a way to bypass the code is revealed, the encryption can be defeated by anyone with that knowledge." [?]

Apple and other technology companies alike believe that if Apple complied and created this "backdoor", it could set a very dangerous precedent.

# 2 QUESTION

Was it ethically justifiable for Apple to refuse the FBI's request to create an operating system that would allow the FBI to unlock the attacker's iPhone?

# 3 SOCIAL IMPLICATIONS

Whether or not Apple's refusal to create a "backdoor" to unlock the phone of the San Bernardino shooter was ethical, there are numerous important considerations on its impact to the information able to be retrieved on personal phones.

When considering the implications of Apple's refusal, there are many criticisms including from FBI Director James Comey. Comey puts it, "Technology has become a tool of choice for some very dangerous people. Unfortunately, the law has not kept pace with technology and this disconnect has created significant public safety problems we have long described as 'going dark.'" [?] Thus, many people consider Apple's refusal to create this "backdoor" to be unjustifiable as it allows dangerous people to keep the information on their phone private. As Republican Senator Lindsey Graham puts it during the GOP Debate in 2016, "Any system that would allow a terrorist to communicate with somebody inside our country and we can't find out what they're saying, is stupid." [?]

On the contrary, many argue that if this "backdoor" was built, it could lead to huge privacy concerns for the general public. John Oliver explains, "If you penetrate a safe, you have only penetrated that safe. But, a code to open a phone could be modified many more phones." [?] Apple's CEO Tim Cook comments, "No one, I believe, would want a master-key built that would turn hundreds of millions of locks even if that key were in the possession of the person that you trust the most; that key can be stolen... The only way we know to get additional information

is to write a piece of software that is the software equivalent of cancer.”[?]

Whether Facebooks “emotional contagion” experiment was ethical or not, there are a number of important societal considerations to be made regarding the usage of big data. A major theme among criticisms of the study is the difference between standards for private and academic research. Cornelius Puschmann, for example, suggests that “the lines [are] deliberately being blurred by the quasiacademic environment cultivated at major internet companies” [?]. This distinction is important because of differences in laws surrounding research in the public and private domains: private research is not subject to approval by an institutional review board (IRB) [?]. Though the study involved researchers from the University of California, San Francisco, and Cornell University, the data gathered by Facebook was considered by the researchers a “pre-existing” dataset that did not need IRB approval [?].

Another important consideration is the broader context of big data usage by major tech corporations. Susan Etlinger questions whether acceptance of the study would “set a precedent to use Facebook or other data to manipulate individuals emotional states for commercial or other purposes via ‘contagion’” [?]. Others point out that Facebook is not the only company to conduct manipulative experiments, and raise concerns about the regulation of private research [?].

## **4 EXTERNAL ARGUMENTS**

### **4.1 Katy Waldman: Facebook’s Unethical Experiment**

In an influential Slate article on the study, Katy Waldman argues that the Data Use Policy’s vague statements about information usage do not constitute a sufficient enough warning to cover informed consent for the experiment [?].

### **4.2 Thomas J. Leeper: Science, Social Media, and the Boundaries of Ethical Experimentation**

Thomas Leeper argues that the experiment aligns in a reasonable way with Facebook’s interest in improving their product and that the Data Use Policy constitutes informed consent in lieu of explicit notification, as it provides for use of user data for product improvement, and users can opt out by refusing to use the product [?]

### **4.3 James Grimmelmann: As Flies to Wanton Boys**

The US Code of Federal Regulations specifies the basic elements of informed consent, mandating explanation of the potential risks of participation in a study and the opportunity to refuse to participate [?]. James Grimmelmann argues that Facebook’s Data Use Policy does not meet these criteria because it “doesn’t even attempt to offer a contact for questions or an opt-out” [?].

### **4.4 Tal Yarkoni: In Defense of Facebook**

The US Code of Federal Regulations also specifies conditions for waiving the requirements of informed consent that protect the welfare of participants [?]. Tal Yarkoni argues that the study satisfies these conditions primarily because of the insignificance and ambiguity of resulting effects [?] and that the manipulation was not different from ordinary experience [?].

### **4.5 Zeynep Tufekci: Facebook and Engineering the Public**

Zeynep Tufekci expresses concern over Yarkoni’s argument and its defense of the status quo, stressing the responsibility of the academic community to “speak up in spite of corporate or government interests” [?].

#### 4.6 Michelle N. Meyer: Misjudgments will drive social trials underground

In agreement with Yarkoni, Michelle Meyer highlights the preexisting manipulative nature of Facebook’s news feed algorithms. She questions whether the experiment posed any significant risk to participants and whether the results conclusively demonstrate an increase in negative emotions. Finally, she warns of the potential consequences of outrage against the experiment [?].

## 5 HOW THE SOFTWARE ENGINEERING CODE OF ETHICS APPLIES

The IEEE/ACM Software Engineering Code of Ethics defines software engineers as individuals “who contribute by direct participation ... to the ... development ... and testing of software systems” [?]. Are the researchers behind Facebook’s “emotional contagion” study software engineers according to this definition?

The Facebook news feed is “software that delivers personalized streams of content” [?]. According to the “emotional contagion” paper, the experiment included the manipulation of an algorithm that filters user content on the news feed: “Which content is shown or omitted in the News Feed is determined via a ranking algorithm that Facebook continually *develops and tests* ... One such test is reported in this study” [?].

Because the experimenters contributed to the development and testing of the Facebook news feed algorithm, a software system, they can be considered software engineers who “shall adhere to the [Software Engineering] Code of Ethics and Professional Practice” [?].

## 6 ANALYSIS

### 6.1 Tenet 1.04: Potential Danger

Tenet 1.04 of the SE Code of Ethics requires software engineers to “disclose to appropriate persons ... any actual or potential danger to the user ... that they reasonably believe to be associated with software or related documents” [?].

#### 6.1.1 Definitions

##### 6.1.1.1 Disclosure to Appropriate Persons

To “disclose” is to “make known, reveal, or uncover” [?]. In the context of research, disclosure is closely related to informed consent, which the Institutional Review Board Guidebook claims “assures that prospective human subjects will understand the nature of the research and can knowledgeably and voluntarily decide whether or not to participate” [?]. This definition regards prospective human subjects as the appropriate persons to which disclosure is directed. According to these definitions, to “disclose to appropriate persons” in research means to “make known to prospective human subjects (users)”, and disclosure should include an opportunity to decide whether or not to participate in the research.

##### 6.1.1.2 Actual or Potential Danger

“Danger” is defined as “liability or exposure to harm or injury; risk; peril” [?]. According to the Research Ethics Guidebook, “harm in social science research includes quite subjective evaluations like distress, embarrassment, and anxiety” [?]. This definition is relevant because social science is “the study of society and social behavior” [?], and Facebook’s “emotional contagion” study “tested whether exposure to emotions led people to change their own posting behaviors” [?]. Therefore, “actual or potential danger” may be defined as “potential risk of distress, embarrassment, or anxiety”.

### 6.1.1.3 Reasonable Belief

Reasonable belief may be defined as “hav[ing] knowledge of facts which, although not amounting to direct knowledge, would cause a reasonable person, knowing the same facts, to reasonably conclude the same thing” [?]. In other words, reasonable belief requires evidence, but not necessarily proof. To “reasonably believe”, then, means to “have evidence to believe”.

### 6.1.2 Domain Specific Rule

In the domain of internet research, tenet 1.04 requires Facebook’s software engineers to “make known to users ... any potential risk of distress, embarrassment, or anxiety to the user ... that they have evidence to believe is associated with the Facebook news feed algorithm.”

### 6.1.3 Discussion

#### 6.1.3.1 Potential Risks

One major defense of Facebook is Tal Yarkoni’s “In Defense of Facebook” article, which questions whether the “emotional contagion” experiment was any different from routine updates to Facebook. Yarkoni argues that “every single change Facebook makes to the site alters the user experience”, and that these updates are made in the interest of improving the user experience [?]. Michelle Meyer agrees, arguing that the “emotional contagion” experiment was ultimately designed to improve the user experience, and that it did not “mess with people’s minds” any more than Facebook usually does [?].

It is important to note, however, that the “emotional contagion” experiment was not conducted as a routine update to the system; it was designed to test “whether emotional contagion occurs outside of in-person interaction between individuals” [?]. Adam Kramer, one of the study’s authors, stated that the researchers’ “goal was never to upset anyone” [?]. The intentions of the study, however, are irrelevant to the potential for harm, which may have been nec-

essary for the experiment to yield beneficial results. Kramer goes on to acknowledge that the study resulted in harm to the subjects: “the research benefits of the paper may not have justified all of [the] *anxiety*” [emphasis added]. Did the researchers have evidence to believe that the changes made for the experiment might cause anxiety before the study was conducted?

The paper on the study makes references to previous studies on “emotional contagion”: “Emotional contagion is well established in laboratory experiments, with people transferring positive and *negative emotions* to others. Data from a large real-world social network, collected over a 20-y period suggests that longer-lasting moods (e.g., *depression*, happiness) can be transferred through networks” [emphasis added] [?]. These references are clear acknowledgments that the phenomenon of “emotional contagion” has been demonstrated to include the spreading of negative emotions (including the anxiety that Kramer acknowledged). As the study was designed to examine “emotional contagion” via Facebook News Feeds, the researchers must have considered the possibility that negative emotions could be successfully spread during the experiment. Therefore, the studies cited in the paper constitute sufficient evidence for the potential risk of negative emotions, including anxiety, associated with the software relevant to the experiment.

#### 6.1.3.2 Making Risks Known

If the researchers had sufficient evidence for potential risk, did they make these risks known to the subjects of the experiment?

As previously mentioned, disclosure is an important component of informed consent [?]. The researchers state that because they did not personally see any user data, the experiment “was consistent with Facebook’s Data Use Policy, to which all users agree prior to creating an account on Facebook, constituting informed consent” [?]. James Grimmelman agrees that this is “a meaningful way of avoiding privacy harms”, which is a “principle risk” in observational stud-

ies [?]. However, he goes on to point out that the “emotional contagion” study was an experimental study, which carries more potential risks than just privacy risks. Indeed, the paper does not directly address other potential risks associated with informed consent, including the risk of distress, embarrassment, or anxiety.

If the researchers claim that Facebook’s Data Use Policy constitutes informed consent, does it also address these risks? The policy states that Facebook “may use the information [it] receive about [users]: ... for internal operations, including troubleshooting, data analysis, testing, *research* and service improvement” [emphasis added] [?]. However, Kashmir Hill points out that the term “research” was added four months after the study was conducted [?]. This means that the Data Use Policy could not have been considered notification of participation in the study at the time it was conducted. As many critics point out, Facebook did not provide any explicit notification of participation in the study, and it was conducted without the subjects’ knowledge [?] [?] [?] [?]. Therefore, the subjects could not have been aware of any potential risks associated with the experiment, since they were not even aware that they were subjects of an experiment in the first place.

#### 6.1.4 Conclusion

The researchers behind Facebook’s “emotional contagion” study had evidence to believe in potential risks of anxiety to human subjects associated with the software used in the experiment. The domain specific rule above, derived from tenet 1.04 of the Software Engineering Code of Ethics, states that they were required to make these risks known to the participants of the experiment. Because participation in the study was not made known to the subjects, they could not have been aware of these potential risks, and this rule was not satisfied.

## 6.2 Tenet 2.03: Knowledge and Consent

Tenet 2.03 of the SE Code of Ethics requires software engineers to “use the property of a client ... only in ways properly authorized, and with the client’s ... knowledge and consent” [?].

### 6.2.1 Definitions

#### 6.2.1.1 Property

Digital content consists of “individual files such as images, photos, videos, and text files ... stored either on a device owned by an individual (locally), or on devices accessed via the Internet (in the cloud), often as part of a service offered by a third party and governed by a contract with the individual”, and digital content can be considered “intangible, personal property” [?]. User generated content is defined as “published information that an unpaid contributor has provided to a web site”, which can include “a photo, video, blog or discussion forum post, poll response or comment made through a social media web site” [?]. Because social media posts are user generated content, a form of digital content, and digital content is considered personal property, social media posts can be considered property. In the context of social media, “property” therefore includes “social media posts”.

#### 6.2.1.2 Client

A client is “a customer or a person who uses services” [?]. A service “[supplies] public communication” [?]. Social media is defined as a form “of electronic communication... through which users create online communities to share information” [?]. Because social media supplies public communication, it can be considered a service. Therefore, “clients” includes “users” of social media software.



### 6.2.1.3 Proper Authorization, Knowledge, and Consent

To authorize is to “give official permission for or approval to” [?], and consent is “permission for something to happen” [?]. Because authorization and consent are explicit actions, they cannot be properly given without adequate knowledge of the situation, and knowledge can be considered a necessary component of consent and authorization. Given the overlap between consent and authorization, and the necessity of knowledge in both, “proper authorization, knowledge, and consent” can be simplified to “official approval”.

### 6.2.2 Domain Specific Rule

In the domain of social media, tenet 2.03 requires software engineers to “use the social media posts of a user only in ways officially approved by the user.”

### 6.2.3 Discussion

As previously mentioned, Facebook researchers claimed that the “emotional contagion” study was conducted in accordance with Facebook’s Data Use Policy, which they cite as sufficient informed consent [?]. In order to justify this claim, the use of user posts in the experiment must be compared with the Data Use Policy, both of which will be examined in the following sections.

#### 6.2.3.1 Use of Users’ Posts

In what ways did the Facebook researchers use the users’ posts?

The “emotional contagion” paper states that user posts were analyzed by the “Linguistic Inquiry and Word Count software (LIWC2007) word counting system” in order to determine whether they were positive or negative [?]. This data was then used to determine the posts’ likelihood of omission from the users’ news feeds according to the experimental condition they were assigned to. No new posts were added to the

users’ news feeds; the experiment only involved post omission. Finally, the paper makes clear that all posts were still accessible via the poster’s personal “timeline”, and that no personal private messages were affected by the experiment [?].

To summarize, user posts were analyzed for emotional content and used in the experiment to skew the prevalence of positive or negative posts in participants’ news feeds.

#### 6.2.3.2 What The Data Use Policy Authorized

What did Facebook users approve of by agreeing to Facebook’s Data Use Policy?

In May 2012, Facebook amended its Data Use Policy, adding a line stating that user data may be used “for internal operations, including troubleshooting, data analysis, testing, *re-search* and service improvement” [?]. Prior to this amendment, which was made *four months* after the “emotional contagion” experiment was conducted, there was no mention of research in the document.

A number of critics of the experiment refer to the updated Data Use Policy without stating that this line did not appear in the document when the experiment was conducted [?]. Thomas Leeper, in his analysis on the ethics of the experiment, argues that agreeing to the policy gives Facebook permission to use user data as long as it is “de-identified”, a statement he justifies with the following line from the policy: “we don’t share information we receive about you with others unless we have: received your permission; given you notice, such as by telling you about it in this policy; *or* removed your name and any other personally identifying information from it” [?]. While the data was analyzed in an anonymous fashion, Leeper’s defense leaps to authorizing Facebook to “use [user] data however [it] want[s]” even though this line only authorizes sharing of anonymous data. While the previously mentioned line regarding research may have provided such authorization, the latter does not address usage outside of sharing anonymous data,

and therefore does not constitute official approval of the experiment by users.

#### 6.2.4 Other Means of Authorization

If the Data Use Policy did not provide official approval at the time of the study, was there some other way Facebook gained approval for the use of user posts in the experiment?

One way to gain approval for the experiment would be to request it directly from the participants. However, as discussed in section 6.1.3.2, Facebook did not provide explicit notification of participation in the experiment. Even if participants had been notified, though, such notification would only have been relevant to participants' data. Because the experiment involved filtering posts from the participants' friends, Facebook would have needed approval from non-participants as well. Because notification of the experiment was not provided to either the participants or their friends (see Section 6.1.3.2), Facebook could not have gotten approval for the experiment from them directly.

#### 6.2.5 Conclusion

The researchers behind Facebook's "emotional contagion" study used user data for the purposes of research and experimentation, and they cited Facebook's Data Use Policy as informed consent. Though this document may have constituted official approval for the use of user posts in the experiment, provisions for use in research were not added until four months after the experiment was conducted; no mention of research was made in the document at the time the experiment was conducted. In addition, no notification of the experiment was provided to participants or other users whose posts were used for the purposes of the experiment; the Data Use Policy was the only document through which Facebook attempted to gain approval for the use of user posts. Because this document did not mention research or experimentation at the time of the study, it did not sufficiently gain this approval. The experi-

ment therefore used user data in ways not officially approved by the user, and was in violation of the domain specific rule derived above from tenet 2.03 of the Software Engineering Code of Ethics.

### 6.3 Tenet 2.05: Privacy

Tenet 2.05 of the SE Code of Ethics requires software engineers to "keep private any confidential information gained in their professional work, where such confidentiality is consistent with the public interest and consistent with the law" [?].

#### 6.3.1 Definitions

##### 6.3.1.1 Keeping Private

In the context of digital data, privacy "deals with the ability an ... individual has to determine what data in a computer system can be shared with third parties" [?]. More generally, privacy is "the state or condition of being free from being observed or disturbed by other people" [?]. These definitions suggest that to "keep private" is to "maintain freedom from observation by other people".

##### 6.3.1.2 Confidential Information

Something that is "confidential" can also be considered "secret or private" [?]. Given the above definition of privacy, "confidential information" means information of which access to third parties is determined by the owner of the information. Because data is information [?], and data is the relevant information in social media, "confidential information" means "data that is intended to be accessed only with permission of the owner". As discussed in Section 6.2.1.1, the relevant data is a user's social media posts, and the owner is the user who generated that data. Because Facebook's privacy settings provide users with the opportunity to decide who has permission to see their posts [?], "data that is intended to be accessed only with the permission of the

owner” includes social media posts. Therefore, “confidential information” includes “social media posts”.

#### 6.3.1.3 Professional Work

Something that is “professional” “relat[es] to a job that requires special education, training, or skill” [?]. Because “a software engineer is a licensed professional engineer” [?], “work done in a software engineering job” can be considered “professional work”. Because the Facebook researchers are software engineers (see Section 4), the “emotional contagion experiment” is the relevant professional work.

#### 6.3.1.4 Public Interest

“Public interest”, though a nebulous concept, is defined as “the welfare or well-being of the general public” [?]. Without getting into too much detail, “public interest” is “the welfare of the general public”.

### 6.3.2 Domain Specific Rule

In the domain of social media research, tenet 2.05 requires software engineers to “maintain freedom from observation by other people any social media posts gathered during the ‘emotional contagion’ experiment, where such confidentiality is consistent with the welfare of the general public and consistent with the law”.

### 6.3.3 Discussion

#### 6.3.3.1 What Was Gathered During the Experiment?

As mentioned in Section 6.2.3.1, social media posts were gathered for the 689,003 users who were involved in the experiment. These posts include those made by the participant users, but also users they are connected to whose posts were filtered by the news feed algorithm. This amounted to a total of roughly 3 million posts [?].

#### 6.3.3.2 Who Observed the Data?

Also mentioned in Section 6.2.3.1, the “emotional contagion” paper states that posts were analyzed by the “Linguistic Inquiry and Word Count software (LIWC2007) word counting system” for the presence of positive or negative content, and that “no text was seen by the researchers” [?]. As mentioned in 6.1.3.2, James Grimmelman agrees that “automated data processing is a meaningful way of avoiding privacy harms to research subjects” in spite of his criticism of the study [?]. Because the users’ posts were analyzed by software and not seen by people, the researchers did “maintain freedom from observation by other people” with regards to social media posts.

#### 6.3.3.3 Welfare of the General Public and the Law

If the researchers complied with the domain specific rule in maintaining the privacy of user data, are there any reasons why this was not consistent with the public good or the law?

Experimental psychology is defined as “the branch of psychology dealing with the study of *emotional...* activity... in humans... by means of experimental methods” [?]. Because the “emotional contagion” experiment studied emotional activity, it can be considered a psychological experiment. The American Psychological Association has a code of ethics that addresses disclosure of confidential information. The APA Ethical Standard 4.05 justifies the disclosure of confidential information when permitted or mandated by law, or for valid purposes such as protection of “the client/patient, psychologist, or others from harm” [?]. This standard also states that “the legal duty [of disclosure] is based upon a clinical assessment”.

Would observation of the user data have protected anybody from harm? The users’ posts were only analyzed for the purposes of finding positive or negative content, and the analysis was only used to tag posts as positive or negative for omission from the news feed. Because of this, re-

searchers could not have been able to determine whether posts demonstrated a risk of harm to anybody. Furthermore, as the data was not assessed by the researchers, there could not have been any legal duty to disclose information.

#### **6.3.4 Conclusion**

The Facebook researchers who conducted the “emotional contagion” experiment gathered roughly 3 million social media posts for the purposes of the experiment. The domain specific rule derived above from tenet 2.05 of the Software Engineering Code of Ethics mandates protection of this data from being observed by other people unless justified by the interests of the public good or the law. Because the data was analyzed by software without being seen by people, it was successfully protected from observation. Furthermore, because the posts were not assessed, no legitimate risk of harm could have been found to justify the disclosure of the data as consistent with the welfare of the general public or the law. Therefore, the experiment was conducted in compliance with the domain specific rule, and tenet 2.05 from which it was derived.

the Data Use Policy is sufficient for gathering this approval, the document did not mention research until four months after the study, and therefore could not have gathered official approval at the time of the experiment. Finally, because the posts were analyzed by software and were not seen by the researchers, the privacy of confidential information (users’ posts) was maintained in accordance with tenet 2.05. As no assessment was made of the data, there could not have been justification for disclosure according to the welfare of the general public or the law.

### **6.4 Conclusions of Analysis**

To summarize the conclusions of the prior analysis, the “emotional contagion” experiment conducted by Facebook researchers was in violation of tenets 1.04 and 2.03 of the Software Engineering Code of Ethics, but was in compliance with tenet 2.05. The researchers had sufficient evidence for potential risks of anxiety to participants, and were required to make those risks known to the participants according to tenet 1.04. Because participation in the study was not made known to the participants, they could not have been aware of these risks. In addition, this lack of notification shows that the participants could not have given official approval for the use of their data in the experiment, as required by tenet 2.03. Though Facebook claims