The effects of security controls on human behavior in online social networks.* A Behavioral Analysis.

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ABSTRACT

Internet is a conglomeration of networks on a worldwide scale of billions of interconnected computers that provides an increased potential for interaction between humans, since one of the main characteristics of the Internet is to facilitate the production of a social episode. Because there is a relationship between humans and the online environment, the Internet should be part of the study of behavior analysis and behavioral science itself can use the Internet as a potential laboratory to assist in understanding human behavior and understand the effects caused by these new behaviors.

Understanding the variables that affect these behaviors, as well as the reinforcement contingencies that control them can bring an advantage in relation to the prediction and control of human behavior, including questions concerning the proper and effective development of new technologies that provide benefits to the academic world, science, society, and organizations. The objective of this paper is to present methodological considerations that were stemming from an experimental research that made use of the Internet as an experimental laboratory for studying the negative effects that security controls can exert on the behavior of online users. The results of this research point to the opportunity of developing new research for understanding human behavior on the Internet and they highlight the need to invest in studies and to improve the procedures used. We also believe that this study could contribute to the behavior analysis and other sciences can use the Internet as a laboratory in order to better understand the contingencies that control online behavior and encourage the adequate development of systems to bring the best experience to Internet users.

Categories and Subject Descriptors

H.1.2 [**Models and Principles**]: User/Machine systems—*systems–human factors, human information processing*; K.4.1 [**Computers and Society**]: Public Policy Issues—*human safety*; K.6.5 [**Management of Computing and Information Systems**]: Security and protection

General Terms

Experimentation, Human Factors, Security

Keywords

Behavior Analysis, Online Social Networks, Security Controls

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1. INTRODUCTION

The goal of behavior analysis is to understand behavior as a relationship between the organism and environmental events, which includes the history of these interactions. Behavior itself and its evolution are the result of the relationship between the actions of an organism and the environmental stimuli, whether antecedent or subsequent, be it private or public. For the behavior analyst, understanding the behavior requires an appropriate use of the principles and procedures of a natural, experimental science in order to clarify the uniformities of the relationship between organism and environment and to make explicit both the relevant variables that may affect it and the history that built the behavior[10]. A consistent and integrated experimental program can provide resources and controls that are adequate to discover new behavioral phenomena[9].

This work is basically done in a laboratory, a controlled environment, which offers the best conditions to obtain reliable results for a scientific analysis. The study of human behavior in the laboratory is extremely useful because it allows for the behavior analyst to investigate variables that control behavior and deliberately manipulate them[3]. The product of laboratory work can help scientific community in developing techniques, concepts, and vocabulary that are appropriate in assisting in the study of complex events and behaviors that interact simultaneously in different environments.

One of the main challenges for the behavior analyst is to monitor changes in behavioral patterns resulting from the advancement of technology and culture which need to be analyzed according to current social/cultural contingencies . Some examples of social/cultural contingencies created with the advancement of the technology of information systems and behaviors emitted through the Internet environment are using an online chat room or attending classes through video conferencing.

For the behavior analyst to be able to face this challenge of understanding these new behaviors, it is important to invest in studies that produce techniques and procedures for the development of experimental research, in order to clarify under natural conditions the uniformities of the social/cultural relations and different environments. In addition to the above challenges, for matters involving online interventions, it is also necessary to understand the new technologies and the behavioral contingencies created with the advent of the Internet environment.

One possibility for predicting and controlling these new behavior patterns is to replicate in a lab the conditions of this new scenario making it possible to manipulate the variables deliberately, changing them in a controlled manner, and observing the results.

The objective of this paper is to present methodological considerations that were stemming from an experimental research[5][1] that made use of the Internet as an experimental laboratory for studying the negative effects that security controls can exert on the behavior of the online users when these controls are inserted deliberately into the contingencies for using online services. Our findings may contribute to behavior analysts as well as researchers of other sciences[2] using the Internet as a laboratory for the study of behavior.

2. INTERNET: AN ENVIRONMENT OF GROWING BEHAVIORAL INTERACTIONS

Internet is a conglomeration of networks on a worldwide scale of billions of interconnected computers that provides humans with a series of services operating 24 hours a day, 365 days a year. With the technological advances of recent years, Internet hit the mark in 2012 of more than 2.4 billion[3] of people connected through computers, smartphones[4] or tablets.

The progress in the number of Internet users indicates an increased potential for interaction between humans, since one of the main characteristics of the Internet is to facilitate the production of a social episode in which each service provider or user is an important part of the other individual's environment[10].

The success, growth and constant use of Internet show that this environment offers many benefits to the academic, social, and professional worlds. From the standpoint of behavior analysis, this phenomenon can be explained by the notion of an environment that, like any other, provides new means for obtaining reinforcers. The great mass of online users generate consequences that easily exceeds the total of the consequences that could be achieved if members acted separately. Thus, understanding the variables that affect the behavior of Internet users, as well as the reinforcement contingencies that control them, can concede an advantage in relation to the prediction and control of human behavior, including questions concerning the proper and effective development of new technologies that yields benefits to the academic world, science, society, and organizations.

3. PSYCHOLOGY, BEHAVIOR ANALYSIS, AND INTERNET

Many other behaviors can be observed with the increased use of Internet in the global scenario and the resulting increased social interactions between humans. The provision of health care services through the Internet is evolving rapidly and can bring benefits to complement and produce other treatments that minimize economic, socio-cultural, and geographical limitations. Psychological interventions via the Internet can help reduce many of the traditional barriers that a face-to-face treatment might present, including breaking the barrier of space for locomotion and availability of skilled professionals, delay time for information dissemination, treatment compliance, costs, and other inconveniences of the treatment and exposure.

Probably choosing an online service, such as online social network sites (SNS), for example, will be influenced by the history of previous reinforcement of this user that determined which stimuli control his/her behavior. For SNS services, is remarkable the preference in choosing services that have the highest number of registered users and that use the service, indicating a greater availability of access to reinforcers. In another example, a stimulus that can influence the response of choosing a social service online chat room is the information that describes the number of users in a room. This control must be due to a previous history of reinforcement of switching to rooms with a higher amount of users (creating greater likelihood of obtaining reinforcers) and/or by imitation–behaving as others behave generates reinforcement[10].

By using the Internet, professionals and/or patients can gather and exchange information in real time when necessary, and treatments can be presented in detail by means of a visual system and/or through animated videos to increase the understanding of a clinical procedure. Patients follow the development of treatment remotely at any time, and the Internet provides the opportunity for psychologists to provide specific behavioral treatments and to individuals who prefer or need to seek help from their own homes or community centers with Internet access.

A practical example of using the Internet is the project Doe Palavras[5][donate words] developed by the Mario Penna Institute in Belo Horizonte (MG), Brazil, whereby patients treating cancer can read messages of optimism real time sent by friends or Internet users. The messages are sent through the project's site and the phrases appear on 12 TVs installed in the units of chemotherapy, radiotherapy, and waiting rooms of the hospital. The project's goal is to create a database containing phrases that convey comfort and hope to patients and family members. In 20 days of the campaign, the site was accessed more than 242,000 times, and the hospital received more than 53,000 messages from all over Brazil and abroad.

Behavior analysts need to understand and recognize that technology is changing human behavior[8], and it is important that the analysis of the behavior be an integral part

[1]Write that experimental research was submitted to the ACM Conference PSOSM '13 May 14, 2013 Rio De Janeiro, Brazil(appendix A)

[2]Other sciences such as engineering, computer science, and social sciences have developed research using the Internet; therefore, part of the objective of this research is to work with the other sciences.

[3]http://mashable.com/2013/01/17/the-internet-in-2012-634-million-websites-2-4-billion-users-1-3-trillion-google-searches/

[4]http://edition.cnn.com/2013/01/30/tech/social-media/facebook-mobile-users

[5]http://www.doepalavras.com.br

of the development of the Internet systems so that this integrating group of developers can understand and recognize the contingencies of reinforcement responsible for repertoires acquired by its members, including the special contingencies maintained by a cultural environment.

While it is unlikely that interventions via Internet will replace the personal and traditional treatment, there is little doubt that these interventions will grow in importance as a powerful element of support for treatments and control of human behavior[8].

4. RELATEDWORK

4.1 Internet as an Experimental Laboratory

The Internet is composed of many technological devices that make it work. The technological characteristics of the various equipment and how the online services are developed make it possible to accurately record any operation performed on the online services such as analyzing the behaviors emitted in the online environment of a given user identified by means of the authentication process in a service. It is possible to analyze the relationship between user's responses and online environmental stimuli, including the antecedent and consequences stimulus.

Internet can be used as a complementary tool to study human behavior. Such an environment allows, for example, of to simultaneously study the behavior of millions of users with accuracy, including the manipulation of variables and the observation of the result. This advantage allows the researcher to select a certain group of participants and to exert manipulations of independent variables in the online environment.

The use of the Internet as an experimental laboratory can assist in studies on aversive control[6], minimizing the controversies about the use of aversive contingencies in experimental or applied researches and with the possibility of further developing effective analyses for the change of inappropriate behavior and to understand the phenomena of averseness[6, 4, 11]. You can, for example, to study the effects of punishment that is currently imposed on users who do not follow the rules of use or the security policy of an online service or to control the cost of response of users who are dependent on Internet access.

A practical example of using the Internet for the production of knowledge is a survey[12] that the Bulgarian government is sponsoring with the aim of revealing the expectation of clients seeking psychological help through using e–mail, video conferencing, network of discourses etc. An intervention study via Internet[7] made use of an experimental procedure to evaluate the effects of the intervention over the Internet in which the objective was to increase the number of words written by fiction writers. Another study[2] proposed a token reinforcement program using the Internet to promote abstention from cigarette smoking.

Due to an existing relationship between humans and the online environment, the Internet should be part of the study of human behavior analysis and behavioral science itself can use the Internet as a potential laboratory to assist in understanding human behavior and understand the effects caused by these new behaviors.

[6]Several online services already subject their users to aversive conditions, such as blocking the user's access to the Internet if there is any outstanding financial debt with the service provider.

5. METHODOLOGICAL CONSIDERATIONS

It is important that the behavior analysis studies and explains the relationships established among the Internet users and between the user and the Internet itself as an environment. The Internet allows, for example, the study of stability, frequency, behavior patterns, and of the variables that can affect the behavior of thousands of users in a natural environment.

However, to be able to use the Internet as an experimental laboratory considering natural phenomena, it is necessary to develop strict procedures that provide the experimenter with an adequate control over the experimental variables and to be able to use them. In doing so, the experimenter can manipulate directly the experimental variables of access or online service and to investigate the variables that control the behavior of users.

5.1 Enviroment

Considering that the Internet is an available resource (environment) and that the social phenomena that occur in this environment correspond to a natural phenomenon, it is important to understand that browsing on the web by a user can be considered a free operant, whose occurrences are determined by the life of the user (hereinafter referred to as participant).

The natural conditions that control the behavior of the participant also control the frequency of Internet access and/or the behavioral pattern of using online services. For example, during sleeping time, the participant is unable to interact with the online environment. The influence of strange variables and other behavioral phenomena such as the development of a chronic disease can also exert effects on the behavioral patterns.

In addition to the variables that can influence the Internet access behavior mentioned above, the availability of Internet access should be considered as a criterion for the experimental control. The very architecture of the Internet itself provides control mechanisms in order to ensure levels of quality for the availability of the environment, and this management is the responsibility of the online service providers.

Even if the participant can interact whenever this environment is available, the researcher does not have the knowledge of or the access to all the variables that individually control the greater or lesser likelihood of the occurrence of the access behavior and/or use of the service, and for this reason is a situation that becomes uncontrollable. But while the participant is online, it is possible to have the necessary elements to analyze the behavioral pattern and to manipulate the variables of this environment.

5.2 Criteria for controlling the environment

Due to the need of information integrity and accuracy of records, the Internet infrastructure, servers, and applications must meet the criteria described in the manual of the Internet Steering Committee – Safe Practices for Internet Network Administrators and best practices for managing such an environment.[7] The servers that register access

[7]http://www.cert.br/docs/seg-adm-redes/seg-adm-redes.html

logs of the online service users should have their date and time synchronized – use of NTP (Network Time Protocol) services.

5.3 Behavioral Pattern

Upon recognizing that the Internet access behavior and the behavioral pattern of using online services are controlled by natural conditions and that this poses a challenge in controlling all the variables, it is necessary that the researcher takes into consideration the issues described above, so as to make he/she better able to outline procedures to improve the experimental control and to identify what changes in the environment may be responsible for changes in the behavior pattern of the participants. Thus, even if there are many variables that can influence and modify greatly the behavior of each participant, it is important to consider that an oscillation in the behavior pattern can be regarded as an acceptable pattern and that the pattern of the group itself can serve as a control factor, even though there are various types of participants within the analysis group.

5.4 Selection of Participants

The process for selecting research subjects should result in a list of unique participants. Information that can represent the same participant with the lowest probability of error is the registry of authentication by the online service provider. This registry can be used to classify the participants individually, while still preserving their identity through a process of protection of information. The authentication involves the process of validation of the digital identity of the subscriber that checks if the name, login, and password provided by the participant are in agreement with the records stored by the service provider, considering that the password is the exclusive property of the subscriber.

In order to gain control over the authentication process, the risk of selecting participants who have had their password compromised (sharing of the password by the participant or password theft by viruses) should be minimized. If the password is compromised, two or more people can simultaneously access the service damaging the analysis of the behavior of each participant. In order to minimize the risk described above, it is necessary to evaluate the behavior of online service access by a participant from various sources (IP addresses) and correlating them with each authentication process that records these sources, and to establish a control that selects only participants who were not authenticated by more than one person. According to the online service records, it is important to evaluate which data can be used to identify the participants who were authenticated by more than one person by using, for example, data from User-Agent, GeoIP, IP address, device type, authentication, among others.

5.5 Criteria of Stability

To define the stability criterion for the behaviors emitted in an environment with natural phenomena, only participants with a stable frequency of accessing online services should be selected. Participants with a low frequency of access should be eliminated since they have a low probability of showing influence by the effects of the manipulation of the independent variable in the experimental stages. The greater the stability of the accesses, the greater will be the sensitivity to the phenomenon. This is an important aspect because it confers greater sensitivity to a change of environment whose result will be recorded in a research and should be of use for the researcher to monitor daily the possibility of fraud or significant deviations in the behavior pattern that may harm the safety of the service and/or the research.

After delimiting the participants with a profile of accessing online services whose pattern of behavior becomes more sensitive and with a lower likelihood of fraud, meaning that they have a single authentication control by a person who accesses the service and participants with a higher frequency of using the service, it is necessary to submit the records of the dependent variables to statistical analysis[8] in order to select the groups of participants that show similarities in behavioral patterns of using the service; such a procedure will allow to separate them into groups with similar characteristics in the dependent variables in order to determine the stability criteria for the research.

5.6 Record of access and operations of the participants

The online services can record all the operations of a participant of the service. The variables of access are stored in readable text format, and saved in electronic files that are hosted on the server that offers the service. The set of records is called an access log[9], or simply logs, and are used to describe the registration process of events and relevant variables that involve the interaction of the participants, service, and systems. The service providers are responsible for storing the logs so that they can identify participants and their interactions with the service. These logs should be stored and handled according to the laws in force with controls that preserve the privacy and security of the information.

5.7 Privacy

To use the Internet as an experimental laboratory, a researcher needs to store the information in accordance with strict criteria of confidentiality and to comply with the current legislation of the country, codes of ethics, and privacy contracts made by the online services.

Even though the Internet is a virtual environment, the information about the behavior, personal information (identity), identification (recognition of the user by means of a user code) and authentication, searches, email, e-commerce transactions etc. produced by users in the virtual world can represent data that is confidential and of interest only to the users and therefore private. To provide them without protection puts at risk the privacy of users, organizations, and regions if the online service providers or the researchers do not observe a privacy policy and strict controls for the protection and manipulation of information. Thus, any information that might reveal the identity of a participant must be adequately protected. The researcher needs to receive the registration information protected (it is the service provider that manages and protects the information recorded by the system) and that the records provide traceability of the user through an identification code that is unique and that represents each user with accuracy. That is why it is important that the records pass through a procedure that removes

[8]For example, multivariate technique of Hierarchical Classification for building clusters

[9]http://en.wikipedia.org/wiki/Computer_data_logging

and/or replaces any confidential information from users or systems and the safety of the researcher.

Once the researcher has safe access to log data, he must follow a process for selecting the participants in order to determine the criteria of stability and to gain an experimental control that makes it possible to keep track of the results of each experimental phase.

Thus, in order to determine the experimental delimitation according to the Ethical Principles of Psychologists and Code of Conduct[10], the psychologists/researchers have the primary obligation of taking the due precautions to protect the information obtained through any type of storage, recognizing the extent and limits of confidentiality, which is regulated by law.

In Brazil, since January 15, 2012, researchers must submit for approval by an ethics committee appointed by the ministry of health system called Plataforma Brasil[11] when it has to do with research involving human subjects.

To comply with the requirements for protection of identity and confidential information of the participants, the security process known as Sanitation[1] provides the requirements and adequate procedures for preserving the privacy and security of the information. The process of sanitizing a document or log file involves removing and/or replacing sensitive information from the document so that it can be used with a guarantee of integrity without jeopardizing the participant's information and the researcher's security.

Before receiving the log files for the research, it is important that the researcher validates with the service provider which variables are recorded in the log file. It is necessary to understand the value and description for each variable and, depending on the confidentiality, to classify which variables should be sanitized.

It is advisable that the classification process of the variables be executed and approved by the service provider and that a liability and confidentiality agreement be signed with the researcher describing that the information provided to the researcher is protected under the confidentiality terms and according to the service provider's security criteria, and that the data will only be used for this research.

5.8 Control group and test group

Due to the natural characteristics that involve the Internet and in order to have a condition to better control in this environment, the researcher needs to check the daily availability of the environment and the reliability of the research records through a test group[12] and a control group. The test group corresponds to a participant registered by the researcher that has the signature of the provider or online service. This participant can be used to validate, on an every day basis, the integrity of the records and identify any anomalies that may affect the research results.

5.9 Experimental Procedure

The researcher needs to outline some experimental phases in order to assess the influence that the manipulation of the independent variable can have on the behavior of an online service by the participants. Changin over from one experimental phase to another should ensure that the behavioral pattern is stable.

In the research herein described, the researchers delineated three experimental phases using an A-B-A model. The baseline phase was constituted by the stable behavioral pattern resulting from an analysis of 90 days, and the procedure to switch the experimental phase was carried out when a stable behavioral pattern was reached (analyzing during the data collection).

6. DISCUSSION

One of the objectives of this article was to present methodological considerations issued by planning the experimental research: The effects of security controls on human behavior in online social networks[13].

The results of this paper can collaborate in the development of experimental research for understanding behaviors that emerge with the potential use of Internet. Different behavior analysts[14] describe criteria to affirm that a research is experimental or collaborates with understanding the behavior. A consistent and integrated experimental program can provide resources and controls that are adequate to discover new behavioral phenomena[9].

Furthermore, the demonstration of the basic behavioral processes in simplified conditions enables us to see these processes working in complex cases[10]. This research also contributes to answering some of the seven implications and needs for online interventions[8].

6.1 Discussion of experimental procedures

Some considerations should be made regarding the experimental procedures used in this research. The procedure used, performed under natural conditions, selected the participants taking into account only those with a high frequency and stable access to the chat service. The results of the selection showed that the natural conditions considerably control the frequency of access to Internet by the participants, representing the exclusion of 85% of them for not meeting the selection and security criteria.

In addition to the effects above, it could be seen that the frequency of access of the participants varied during the three experimental phases, representing a decrease in the number of participants through the phases. This condition did not prevent the independent variable effects from being observed. The identification of a behavior pattern in the participants, which enabled the creation of groups of analysis, favored the identification of changing the behavioral patterns at the time when the independent variable was reintroduced (Phase 3).

With regard to the resources needed for developing researches that produce a large amount of records, which was the case presented here, a careful evaluation of the environment must be done by developing a preliminary analysis to estimate the investment required in computers that support the storage and processing of all the records, while also taking into account the estimated time available for execution (processing and memory resources) of each stage of the research.

Another aspect that should also be considered with regard to the environment's resources is that the Internet

[10]http://www.apa.org/ethics/code/index.aspx

[11]http://aplicacao.saude.gov.br/plataformabrasil/login.jsf

[12]Group of users registered by the researcher in order to daily test Internet access and the use of the online service.

[13]Research submitted to the ACM Conference PSOSM '13 May 14, 2013 Rio De Janeiro, Brazil(appendix A)

[14]B. F. Skinner and Murray Sidman

is composed of several telecommunications equipment and computers that make it work, and specifically these technological resources (hardware and software) and operational processes (environment management) are prone to technical errors and problems. Therefore, these situations should be expected and additional controls put in place that can minimize the effects of a problem and notify the researcher.

For example, at the time of the first research, during the collection of access logs, it was realized that the volume of records (access logs) obtained in Phase 2 was much higher (greater than 1GB in size) as compared to Phase 1. In an investigation with the service provider, it was identified that some servers responsible for recording the access log during Phase 1 underwent systemic changes that made it impossible to have a reliable copy of the access logs. Another problem was identified when the participants selected were submitted to Phase 2 (removal of the CAPTCHA stimulus).

At this time, after analyzing the daily results and the test group, it was identified that the behavior of the participants did not undergo any effect or a change after the manipulation of the independent variable. This occurred because the participants selected had a particular feature of the system changed during the research, which resulted in the unexpected modification of the procedure to remove the CAPTCHA: the participants were not subjected to the withdrawal of the CAPTCHA in Phase 2. Due to these problems, the data initially collected were discarded. A new collection was done making sure that all servers stored the access logs properly and that the procedures for handling the VI worked properly.

Even though the control and test groups provided controls on the main aspects of the environment such as full validation of the access records, availability and operation of the environment, only with the test user was it possible to identify a problem encountered in the attempt to remove the independent variable, which depended on complex configurations in the systems of the online service. Therefore, it is suggested that the researcher produce a checklist to give to the service provider all the cases of instability and integrity assurance for the collection and storage of data. This checklist should also include a list of all the technical resources that are part of the Internet working, and procedures that validate that these were operating under normal conditions during the entire research in order to identify potential problems that could affect the development of the research.

Finally, it should be made clear that the procedure employed was effective for the investigation of behavioral phenomena in an online chat environment as it ensured experimental control, which was responsible for the regularity and integrity of the data.

7. CONCLUSION AND FINAL CONSIDERATIONS

The results of this research point to the opportunity of developing new research for understanding human behavior on the Internet and they highlight the need to invest in studies and improve the basic procedures presented here, as well as to have support from the area of computer science, statistics, and engineering for using appropriate techniques in order to further analyze online behavior.

To conclude, it is necessary to recognize that the behaviors of Internet access and use of online services are controlled by natural conditions, which poses a challenge for experimental control, but on the other hand, the trend to use this type of environment grows considerably and, in general terms, its study may offer an important contribution to the science of analyzing human behavior.

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