Mitigating Online Survey Nonresponse Error in Aviation Research

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MITIGATING ONLINE SURVEY NONRESPONSE ERROR IN AVIATION RESEARCH

David Carl Ison

Abstract

As aviation researchers increasingly rely on online and email-based methods of inquiry, it has become ever more necessary to identify the best practices in avoiding the blockage of research-oriented emails by spam filtration software. This study investigated the available literature on the use of email to distribute research surveys. Although data was available on how to and why to conduct research online, the literature lacked information on potential problems associated with the use of email in the conduct of such research. Evidence on how to avoid spam filtration was provided by the *ex post facto* findings of a study of aviation faculty. This data revealed that a dramatic difference in response rate can occur if specialized email construction and delivery techniques are utilized. Finally, a systemic method of survey/email nonresponse mitigation is provided.

Since the early 1980s, the use of the internet has become increasingly ubiquitous throughout the United States. According to the U.S. Census Bureau (2005), the number of households that reported having a computer has increased from 8.2% in 1984 to 61.8% in 2003. Internet use, in terms of a percentage of the total U.S. population, has grown from 18.0% in 1997 to 74.1% in 2009 (Miniwatts Marketing Group, 2009; U.S. Census Bureau, 2005). The utilization of the internet and electronic mail (email) has become virtually omnipresent among certain cohorts, in particular, postsecondary students, staff, and faculty (Dillman, Smyth, and Christian, 2008; Daley, McDermott, McCormack-Brown, and Kittleson, 2003).

The widespread use of the internet and email has prompted researchers to explore these media to assist them in conducting studies. The convenience of electronic communication has led to tremendous use of these conduits to conduct survey research. Specifically, there are an increasing number of aviation-related studies that have utilized email-based survey methods to collect data. Due to the rapid rise in use of online data collection in general and in academic research, a significant amount of literature exists on the advantages and disadvantages of using online surveys as well as the particular methods that have been found to elicit the highest response rates (Fan and Yan, 2010; Daley et al., 2003).

Although there has been a proliferation in the use of electronic means to communicate and to conduct surveys, there has also been a dramatic rise in unwanted email traffic. These undesirable messages, often referred to as spam or junk, now serve as a major annoyance for all who use an email account. Further, these disruptive mailings slow down internet communications, clog servers, reduce productivity, and can be offensive (Committee on Small Business – House of Representatives, 2003). Thus, most users, particularly corporate and academic institutions, take dramatic steps to protect their networks from such messages.

Unfortunately, some well-intended messages get blocked or deleted by such protection systems (Van Selm and Jankowski, 2006). Considering that survey research relies so heavily on response rate, it is critical that researchers understand the possible limitations that may be imposed by security systems on electronically delivered solicitations for studies. Little data is available on such constraints and, in particular, how to mitigate these issues so as to assure the best rates of delivery and in turn the highest possible response rates.

The purpose of this research was to provide a background concerning the impediments that exist to the efficacious conduct of online-based survey research and the methods that researchers can use to best circumvent these strictures. Further, *ex post facto* data from a recent study on
Mitigating Online Survey Nonresponse

aviation faculty conducted by this researcher is provided to give insight into the potential pitfalls that exist when conducting surveys online. Evidence from this data indicates that a dramatic difference in response rate can occur if proper monitoring, specialized email construction, and delivery techniques are utilized.

Virtual Worlds, Commerce, and Crime

The advent of the internet has fostered an environment that permits asynchronous, global, virtual interactions among people and computers. Without question, this interlink has simplified the lives of many, advanced a new realm of commercial interests, and created new means of social interaction and communication. Electronic commerce generated an estimated $175 billion in 2007 and was expected to net $204 billion in 2008 (Knight, 2008). Socialization has taken on new forms with three-dimensional interaction capabilities in computer-generated environments in which individuals can exist as virtual personas with attributes and actions designed by users (Edirisingha, Nie, Pluciennik, and Young, 2009). Online social networking sites have also changed the way persons interact and communicate creating an immediacy of information previously unknown (Wright, 2006). The use of email has proliferated to a daily volume of 210 billion messages worldwide. This number is estimated to more than double by 2012 (Noguchi, 2008).

Yet the “accessibility (anytime, anywhere), affordability (most sites allow for free browsing), and anonymity (the ability to protect one’s identity)” (Nosko, Wood, and Desmarais, 2007, p. 1) of the internet—the very reasons why it has become so omnipresent in today’s society—are also some of its biggest downfalls. The ease of use of the internet has made it a breeding ground for unsavory and sometimes criminal activities. Exacerbating this phenomenon is the problematic nature of policing worldwide traffic often with unknown origins (Wall, 2007). “In 2008, a record-setting 275,284 complaints were filed, according to the latest report of the FBI Internet Crime Complaint Center. Crimes, both fraudulent and non-fraudulent, increased by more than 32% in the United States between 2004 and 2008, and the amount of money reported lost annually skyrocketed from $68 million to $265 million” (Wagner, 2009, p. 15). Much of this insalubrious activity is transmitted via email. Such messages can be used to solicit personal data (known as Phishing), distribute adult or unwelcomed content, overwhelm email servers (known as a denial of service attack), and to distribute viruses (Wall, 2007).

Online Survey Research: A Background of the Lore

According to Van Selm and Jankowski (2006) “the Internet is increasingly used as a tool for and object of social scientific study” (p. 435). Lefever, Dal, and Matthiasdottir (2007) purported that web-based survey research “is an efficient and convenient alternative to the more traditional method of gathering information” (p. 575) such as pencil-and-paper surveys or telephone interviews. Dillman, Smyth, and Christian (2008) stated that email surveys have a variety of advantages over other methods of inquiry such as lower costs, fast turnaround, and ease of data analysis. With such tempting means of conducting research in today’s technologically canted society, it should be no surprise that such methods have quickly caught on among academia, governments, businesses and a variety of industries (Grimes and Steele, 2008; Carter and Belanger, 2005).

Aviation higher education researchers increasingly are embracing online research methods in particular the electronic distribution of surveys. From 1999 to 2009, the Collegiate Aviation Review, one of the primary research journals of aviation higher education, has migrated from a publication with no email based surveys to one with regular appearances of studies that utilized online data collection. In 2005, Bliss, Green, and Larsen utilized an electronic survey to investigate collegiate aviation following the September 11, 2001 terrorist attacks. In 2006, three studies using online survey methods appeared in the journal (Arch and Sherman, 2006; Campbell-Laird, 2006; Johnson, Gibson, Hamilton, and Hanna, 2006). More recently, studies by Prather (2007) and Ison (2009) utilized emails to distribute a survey. Other recent aviation publications have also published studies that relied on email survey methods. Latorella, Lane, and Garland (2002) queried general aviation pilots via email in their investigation of their use and perception of aviation weather sources. Ruiz and Worrells (2009) investigated collegiate aviation professional development courses.

Within non-aviation literature, there are numerous studies that have been conducted on the merit of internet-oriented survey research methods. Most of the data that was available sought to identify advantages and disadvantages of using online methods, as well as making comparisons with more traditional research methods such as self-administered pencil-and-paper surveys and telephone surveys. The appeal of online survey research is based upon a list of advantages that have been identified by researchers. One is that respondents can participate at their own convenience and can decide when and where to complete the survey. [...] Also email surveys can be more detailed and comprehensive than in paper-and-pencil surveys [...]. Others report receiving more complete information through email.
and online surveys (Lefever, Dal, and Matthiasdottir, 2007, p. 576).

Other advantages center on the efficiency and economy of online surveys. Schaefer and Dillman (1998) noted that "email surveys can be done faster than telephone surveys, especially for large samples [...]. The method is also inexpensive, since it eliminates postage, printing, and/or interviewer costs" (p. 3). Daley et al. (2003) agreed: "conducting electronic survey research includes lower costs, faster transmission time, and ease of editing" (p. 117) thus it is readily apparent why researchers have embraced online research methods.

Daley et al. (2003) listed an additional advantage of web-based survey research as "respondents may be more likely to be self-disclosing or less likely to respond in a socially desirable way" (p. 117). Dix and Anderson (2000) added more kudos for online surveys stating such methods offer an "increased degree of flexibility afforded in design and presentation" and allow for advancements that enhance user-friendliness such as "adaptive surveys [...] where subjects can be directed to particular items according to how they have responded to previous items" (p. 84).

A number of studies have been conducted to pin down whether online surveys have comparable response rates to other types of survey methods. According to the University of Texas at Austin (2007), "acceptable response rates vary by how the survey is administered: Mail: 50% adequate, 60% good, 70% very good; Phone: 80% good; Email: 40% average, 50% good, 60% very good; Online: 30% average." Another study by Sheehan (2001) found that "while the number of studies that use e-mail to collect data has been increasing over the past fifteen years, the average response rate to the surveys appears to be decreasing [...] On average, the 31 studies report a mean response rate of 36.83%" (Results sections, para. 2). Lastly, Fan and Yan (2010) suggested using several, mixed-method contacts, i.e. use of both mail and email, which can result in response rates that equal or exceed those encountered with traditional survey distribution and implementation techniques.

Problems with Online Survey Research

Several research studies have identified that little data exists on electronically distributed survey protocols. Also, whilst there has been a tremendous amount of research conducted on the conduct of telephone and mail surveys, there has been a negligible amount of comprehensive research on the use of email surveys (Fan and Yan, 2010). Furthermore, because the use of the internet to distribute and collect survey data has received only reluctant acceptance, "the existence of comprehensive research in this field is relatively scarce" (Dix and Anderson, 2000, p. 85). Through the careful growth of this type of research, however, some potential pitfalls have been identified through the conduct of online surveying.

One downside is that emails may not be read by the intended individual. Thus a survey could be answered by an unintended recipient. Although this is unlikely in most settings due to password protected email accounts and/or computers, it is still a possibility. Another concern is that not everyone has access to the internet or an email account (Fan and Yan, 2010). Yet among certain populations, such as college students and faculty, the use of these technologies is so ubiquitous, it has been discounted as a source of coverage error among members of these groups (Dillman, Smyth, and Christian, 2008). Pocknee and Robbie (2002) identified more concerns through an analysis of literature: "researchers have concerns regarding the reliability of web-based surveys with particular regard to: coverage bias, sample limitations, privacy, poor-response rates, confidentiality” as well as limitations in reaching specific target audiences” (p. 2).

Complicating the use of the internet for research is that an “aura of suspicion often surrounds any stranger-to-stranger communication in cyberspace, even when the declared topic is of mutual interest” (Smith, 1997). So almost by default, random messages advertising for participation in a survey are often met with skepticism. Another major concern that only receives cursory attention within the literature is the fact that:

while email is a wonderful tool for impromptu polling on timely issues, and an extremely useful tool for building a potential sample, its utility for anything more is increasingly questionable in the age of 'infoglut' and pervasive email spamming by unscrupulous marketers (Smith, 1997, Discussion section para. 4).

Thus the quantity of email that is now conducted through the internet itself serves as a potential obstacle. Email users are forced to sift through more and more messages making winnowing the good from the bad ever more difficult. This has led to a variety of protection systems that complicate this evaluation process for the user which means that messages concerning the conduct of surveys may not ever reach the intended recipient. Even worse, the researcher may confuse lack of response from these non-recipients as a lack of interest in participation.

The Dreaded Four Letter Word: Spam

The term spam is typically defined as unsolicited email contacts. Other related terms are "junk" or "bulk" email (Caldwell, 2000, p. 299). Schryen (2007) provided
Mitigating Online Survey Nonresponse

more detail concerning the characteristics of spam, describing it as "electronic [...] sent in bulk, unsolicited, commercial, [use] addresses collected without prior consent or knowledge, unwanted, repetitive, untargeted and indiscriminate, unstoppable, anonymous and/or disguised, illegal or offensive content, [and/or] deceptive or fraudulent content" (p. 8).

Spam has become a major disruptor to electronic communications. Schryen (2007) reported "that spam amounts to more than 50% of all worldwide emails" (p. 9). Other data cited by Schryen (2007) indicated that the historic ratio of legitimate to spam messages has held steady at more than 60% from 2004 to 2006. Microsoft reported more disconcerting statistics noting that 97% of all e-mail communications. Schryen (2007) reported "that spam can be classified as "unwanted messages" (Robertson, 2009, para. 8). A 2009 report released by McAfee, an internet security software manufacturer, indicated that 62 trillion spam messages were sent in 2008 (as cited by Robertson, 2009). All of these undesirable communications waste "100 billion user-hours per year [and...] a single spam message results in 0.3 grams of carbon dioxide being released into the atmosphere" calculated in terms of wasted electricity (Robertson, 2009, para. 4).

These large numbers of spam messages "use system resources on literally thousands of computers, and the CPU cycles and disk space used by these messages do cost everyone [...] money" (Carnicella, n.d.). According to the University of Illinois – Chicago (2000), not only do these unwanted emails have fiscal costs, they also have opportunity costs. Such messages can cause anger, frustration, or potentially offend users. All of these reasons have led to the creation and implementation of sophisticated email protection protocols.

Email Security: Spam Blockers and Junk Mail Filters

A variety of measures have been taken by all types of internet users in an attempt to protect them from the onslaught of unwanted junk email. According to Schryen (2007), there has been a global legislative effort to try to eliminate such electronic harassment. Unfortunately, spam can originate from just about anywhere, it can be bounced among servers scattered across the globe, and is sometimes difficult to track its true point of origin (Schryen, 2007). Operators of consequential computer networks such as those at academic institutions, government agencies, and businesses are interested in doing all that is necessary to protect their networks and their users. As such, sophisticated spam blocking measures have become better over time. Between 2004 and 2007, Google's Gmail continued to reduce the number of spam messages making it through to email users even while spam, as a percentage of all emails, rose to slightly less than 80% in the same time period (Jackson, 2007).

Because of the volume of email traffic that colleges and universities handle on a daily basis, these institutions are truly on the front lines of the war on spam. Several institutions of higher education have academic computing staffs that are tasked with alleviating the spam volume and threats to email accounts of those working on campus (Colorado State University; University of Illinois – Chicago, 2000; Carnicella, n.d., University of South Florida Academic Computing, 2009).

Those seeking refuge from the onslaught of spam typically utilize some sort of technological protection system. In fact, Resnick, Hansen, and Richardson (2004) found that "95 percent of schools [in the U.S. ...] employ filtering software" (p. 67). Some institutions employ their own spam protection systems (Colorado State University, 2009), while others use third party email providers, such as Gmail, which have integral spam protection (Rocky Mountain College, 2009). These technologically-based protection systems work in a variety of ways and come in the form of relatively simple filters to complex software architectures.

Myers (2004) described one method of utilizing a multi-layered protection protocol with "filtering based on subject, content and sender" (p. 43). In addition, "reverse blacklisting technology for checking the IP [Internet Protocol] addresses of the servers sending incoming mail to identify known or suspected spammers" (Meyers, 2004, p. 44) also helps reduce spam numbers. The particular system described by Myers (2004) utilized "concept-filtering technology, which is based on thesaurus matching and natural language processing, to identify and block spam" (p. 44). This is made possible by "monitor[ing] much more than keywords. It also looks at the overall meaning of the message as an individual would to determine if an email is legitimate or spam" (Myers, 2004, p. 44). The University of Illinois – Chicago (2000) described the Eudora filter that the institution uses to protect its email users as a device that "moves all messages that aren't addressed directly to [the user] into a separate mailbox" (Use Email Filters section, para. 1). This prevents messages with redirected addressing typical of spam from being delivered to a primary inbox (University of Illinois – Chicago, 2000).

Colorado State University (2009) described their three-tiered protection system which is comprised of "automatic gateway blocklisting, sender DNS [Domain Name System] lookup, and Proofpoint Protection Server (spamscenter)" (Solving the spam problem section, para. 2). The automatic gateway blocklisting prevents emails from a
server that tends to send large volumes of messages. Sender DNS lookup “ensure[s] that each message contains a valid sender and that each message comes from a valid email server” (Colorado State University, 2009, Sender DNS Lookup section, para. 1). The Proofpoint Protection Server handles suspected spam messages in three potential manners. The first is that spam is quarantined and placed into a folder separate than those available to the addressee. Persons are allowed to view the filtered messages through a notification email termed “an End User Digest” (Colorado State University, 2009, Proofpoint Protection Server section, para. 2). The second possible fate for a spam message is that it will be passed on to the recipient, but will be marked as spam and placed in a specific spam/bulk/junk folder. Finally, messages that are not handled in the aforementioned ways are permitted into the general email inbox of the addressee.

In addition to the previously mentioned measures, Schryen (2007) noted several other methods to block spam. One is whitelisting. This is a listing of acceptable hosts from which emails will not be subject to further spam blocking scrutiny. This method was described to be ineffectual if used by itself but is somewhat valuable if used in conjunction with other protections. Another protective measure mentioned was greylisting which relies on server delays to avoid receiving mass emails. Since spam-generating software typically does not wait to resend messages, thinking the recipient email address perhaps no longer is valid, greylisting can trick spammers and avoid the delivery of an unwanted message. This was deemed of marginal usefulness if the spammer has high quality address information (Schryen, 2007).

Rule-based filtering is another method described by Schryen (2007). This protocol is dictated by rules “created manually by users or automatically. A simple rule may look like this: spam ← (subject contains ‘VIAGRA’) and (body contains ‘Dear Sir’)” (Schryen, 2007, p. 68). Unfortunately, this type of filtration is flawed as spammers simply change a character or the order of letters of a word (e.g. VIAGRA or VAIGRA) to circumvent such a system. An additional winnowing tool is the signature-based filter. This type of protection views only the signature component of an email message examining it and comparing it to “known spam signatures in databases” (Schryen, 2007, p. 68).

One of the more elaborate spam filtering tools is Bayesian filtering. This arrangement is a “statistical filter based on the probabilistic ‘Bayes theorem’” (Schryen, 2007, p. 69). The Ohio State University (2007) stated that:

Bayes’ theorem, in the context of spam, says that the probability that an email is spam, given that it has certain words in it, is equal to the probability of finding those certain words in spam mail times the probability that any email is spam divided by the probability of finding those words in any email.

Simply, Bayesian filters rely on the fact that there is a high probability that spam emails have content that is different than that of legitimate email. Thus email is examined for traits common to messages that are known to be spam. This type of filter also examines the suspect email for items that are unlikely to appear in a spam message such as the recipient’s name, city of residence, or other personal data (Burns et al., 2007). Other things used by Bayesian filters to examine messages are the domain from which it was sent (e.g. those sent from .edu domains are less likely to be spam), what time of day the message was sent (those sent at night at more likely to be spam), if the message was sent to an individual or a larger mailing list, and if the email has any attachments associated with it (Sahami, Dumais, Heckerman, and Horvitz, 1998).

Bayesian filters use the following mathematical formula to determine the likelihood that a message is spam:

\[
P(S|M) = \frac{P(M|S) \times P(S)}{P(M)}
\]

The variables are defined as follows: P is probability, S is spam message, and M is specific word or term (Schryen, 2007). An advantage of Bayesian filters is that they can "learn by adding a newly classified email to the historical data, thus adapting probabilities,” (Schryen, 2007, p. 71) i.e. these filtration software systems can keep up with changes in spam techniques meant to circumvent such filtering efforts.

Unfortunately for legitimate email users, there are times when the Bayesian protection measures go too far, blocking desirable messages. Hu (2000) noted that AOL’s email protection system occasionally would intercept warranted messages. Also, just by the nature of their design, Schryen (2007) noted that all types of spam blockers potentially produce false positives thus preventing desirable emails from making it to intended recipients. This is clearly a major concern for researchers who are depending upon the delivery of email to conduct their research. What is even more problematic is that some filtration systems will accept emails and then transfer them to a quarantine or spam folder thus it appears that the email has been delivered (as opposed to being bounced back to the sender) even though it has not. Thus a researcher can be left with the false impression that
their email recipient list was well constructed and all emails were delivered.

**Email Delivery and Read Receipts/Confirmations**

One method that can be adopted to insure that emails are actually delivered is to utilize delivery receipts. This allows the sender to ask for an automated reply when an email is delivered to intended recipient (Microsoft, 2009). Unfortunately, while this seems to be an excellent means of guaranteeing delivery, there are some problems with this reply system. One is that a server can accept an email and generate a return receipt even though the addressee does not receive the email in their primary inbox. Another is that certain email servers do not support this feature therefore eliminating its utility altogether (Agarwal, 2008). However, even the best intentions can have detrimental consequences. According to Waldron (2008), delivery confirmation requests can tip off spam blocking software thus preventing delivery to the desired recipient.

Email researchers have another related tool that they could use to try to ascertain if their message was delivered and read. This can be accomplished by requesting a read receipt. But just like delivery receipts, this capability does not work with all email servers/providers. Therefore, in theory, the lack of a read receipt response is meaningless (Microsoft, 2009; Agarwal, 2008).

There are a variety of third-party (unrelated to any email server) read receipt providers. One example is SpyPig which imbeds an image that runs a program when an email is opened to generate a read receipt (SpyPig, 2009). Although SpyPig producers do not directly comment on the ability of this type of receipt generator to make it through spam filters, because some spam blockers do incorporate image or embedded object detection, instruments such as SpyPig cannot be guaranteed to deliver read receipts (Schryen, 2007).

**Circumventing Email Security**

The majority of available literature on spam focuses on the prevention thereof with virtually no guidance on how spam filters may negatively influence the conduct of legitimate distribution of email. Even recent, comprehensive studies on factors affecting response rates to online surveys neglected to give the issue of email protection system induced non-response more than a cursory mention (Fan and Yan, 2010; Manfreda, Bosnjak, Berzelak, Haas, and Vehovar, 2008; Porter and Whitcomb, 2005). The avoidance of spam filtration is of interest to a variety of email users particularly to those involved in marketing. Thus, internet marketers have had to learn how to deal with the various features and abilities of spam blocking technologies so as to best undertake methods of working around them. No doubt, spammers have worked hard on this project, too, but do not provide useful data in terms of literature, though something can be learned by the techniques that they use.

Brown (2007) described a number of ways to cut down on the possibility that an email might be identified as spam, though the primary focus was on the design of subject lines: “the subject line is one of the primary methods that anti-spam software uses to identify spam emails” (p 134). Specifically, Brown (2007) suggested that email users should “not use subject lines that shout. All caps is considered to be the same as shouting” (p. 136) moreover, this may trigger spam filtration software. Additionally, it was suggested “not [to] overuse the word ‘free’” (Brown, 2007, p. 136). Other suggestions to avoid blockage of desirable emails were to reduce the use of punctuation, especially the exclamation point, the use of short subject lines, and avoid using symbols (e.g. the dollar sign) (Brown, 2007).

A case study by Gold Lasso, LLC (as cited by Brown, 2007) stated that special attention should be paid to: create messages using content and formatting that does not trigger spam filters. Avoid bold fonts; large red-colored fonts; poor quality images; use of all capitals in the subject line or body of email; use of words such as ‘free, trial, money, quote, sample, membership, and access;' and excessive punctuation (!!!) (p. 56).

Another possible avenue for email researchers and marketers to pursue to insure their messages reach the intended recipients is the use of “spam checkers” which “test the message for spam triggers prior to distribution to the designated list” (Brown, 2007, p. 56). Finally, individuals can check that they have email opt-in status with those who they intend to send messages (Brown, 2007).

**Methodology**

The aforementioned literature outlines the importance of considering the possible effects that anti-spam protections may have on the conduct of email campaigns of any sort. Researchers who plan to rely on the distribution of their research inquiries via emails should consider the best methods to insure the receipt of their contacts so as to maximize the effectiveness of their studies. In particular, the perceived success of survey research conducted through the email will be directly related to the response rates received, yet if only a small percentage of contact emails make it to the intended recipients, responses rates will be unnecessarily low. Considering that aviation researchers are increasingly turning to email and online based methods of inquiry, it is critical that these individuals have the best data possible to conduct successful and meaningful technologically based studies. To illustrate the importance of taking spam filtration into account when conducting email based research, *ex post facto* data from a study of aviation faculty was analyzed to determine response rates prior to and following the use of alternative email construction methods.
Mitigating Online Survey Nonresponse

Purpose

The purpose of the ex post facto data component of this study was to provide insight into the potential problems that may arise for aviation researchers conducting surveys online and the dramatic difference in response rate that can occur if specialized response rate monitoring, email construction, and delivery techniques are utilized.

Participants

The data used in this study were based on the findings of a previous study that was conducted by this researcher on a population of postsecondary professional pilot education faculty. The unit of analysis for this study was the individual professional pilot education faculty member who was a full-time faculty member at four-year University Aviation Association (UAA) member institutions within the United States. Individuals were selected by first identifying the institutions that provided four-year professional pilot education programs and were UAA members. This list was generated using the 2008 UAA Collegiate Aviation Guide.

Next, each website of eligible institutions was mined for faculty contact data. The mining process produced 329 potentially eligible individuals. During analysis of the mined data, thirty-three individuals were identified who had left their positions, were not in teaching positions, or were not professional pilot faculty. An additional three were found to be part-time employees. A preliminary population numbered 293 individuals.

Procedure

A survey was distributed to the identified list of individuals using the automated email function of the Survey Monkey internet platform. Procedures to maximize response rates, as recommended by Dillman, Smyth, and Christian (2008), were adopted. This included a plan to use a five-step contact process. The first step was a general email notification message to inform individuals of an upcoming request for their participation in a survey (see Appendix A). A second message was sent through an automated scheduled delivery via Survey Monkey. This email included a link to the survey imbedded within the message (see Appendix B).

Following the delivery of this second contact, it became apparent that something was amiss with the delivery of emails to certain institutions as there was an apparent pattern of nonresponse from these particular institutions. This was confirmed via communication with three colleagues at one of the suspected institutions. It was discovered that emails with links embedded within them were sent to the email junk folder and/or were blocked entirely.

After consulting with literature on email generation and spam blocking software, it was determined that a specially designed follow-up email would need to be sent to insure more complete coverage of the population. An additional email contact was drafted and delivered (see Appendix C). The email directing individuals to this new website was carefully constructed using the standards to minimize identification as spam outlined by Brown (2007) and Schryen (2007) so as not to draw the attention of protective email filters.

A special website was created to which respondents were directed to alternatively enter the survey. This website was password protected to insure that unauthorized users could not access the survey. A new link was inserted into the alternative second contact, however, the hyperlink function for the web address was disabled. The use of a hyperlink was surmised to be the spam filter trigger, both from the data in the literature as well as the fact that the original Survey Monkey, which just had text, was permitted through to respondents at all institutions. To insure that email filtering did not occur, each email was individually drafted and sent, so as not to trigger suspicion of a mass email.

Results

The first contact email was sent to 293 individuals. It was suspected that 83 (28.3%) emails were blocked or filtered even though no messages were bounced or indicated to be blocked due to the fact that the majority of these non-respondents were employed at the same institution. This mass-blockage was confirmed through communication with three individuals who were faculty for the aforementioned employer. Eighty-three emails were then individually sent via Microsoft Outlook utilizing the specially designed delivery and message contact construction mentioned previously.

Following the delivery of the alternatively designed email contact, 69 (23.5%) of the total distributed surveys or 83.1% of the blocked message recipients) responses were received. By the end of the survey collection period, a total of 235 (80.2%) responses were received. Among these 235 responses, nine (3.1%) were refusals to participate, four (1.4%) were incomplete, and 29 (9.9%) were found to be ineligible due to responses (e.g. individual was determined not to be a professional pilot program educator). Therefore the total, usable responses numbered 193 or 65.8% (see Table 1). Because the current study sought only to identify the potential of improved email construction and distribution and not to report the findings of the survey itself, such data is omitted for succinctness.1

1 The actual findings of the survey can be found in Ison, D. C. (2009). Pathways to the aviation professoriate: An investigation into the attributes and backgrounds of professional pilot education faculty. Collegiate Aviation Review, 27(2), 28-44.
Mitigating Online Survey Nonresponse

Discussion
Although it cannot be assured unquestionably, evidence conveyed by individuals at the institutions which were suspected of having blocked the second Survey Monkey email indicates that individuals would have been missed if email response monitoring was not conducted. As such, it can be expected that the response rate without such efforts and the follow-up procedure utilized would have been substantially lower. Using the collected data as an example, only 124 (42.3%) responses would have been available without the additional procedural adjustments to account for spam filtration. As previously indicated by the University of Texas at Austin (2007), this level of response would be considered marginal, at best. However, with the ending response rate of 65.8%, the study was deemed to have a very good rate of participation (University of Texas at Austin, 2007).

Table 1 Summary of Response Rate Subcomponents

<table>
<thead>
<tr>
<th>Returned (vs. 293 total sent)</th>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total replies</td>
<td>235</td>
<td>(80.2)</td>
</tr>
<tr>
<td>Refusals</td>
<td>9</td>
<td>(3.1)</td>
</tr>
<tr>
<td>Positive responses</td>
<td>226</td>
<td>(77.1)</td>
</tr>
<tr>
<td>Incomplete responses</td>
<td>4</td>
<td>(1.4)</td>
</tr>
<tr>
<td>Complete responses</td>
<td>222</td>
<td>(75.8)</td>
</tr>
<tr>
<td>Ineligible responses</td>
<td>29</td>
<td>(9.9)</td>
</tr>
</tbody>
</table>

| Total usable, qualified responses | 193 | (65.8)|

The findings of this study have even broader implications as it may be necessary to review previous research utilizing online data collection, particularly those with poor response rates. It is certainly possible that some of the deficiency in response rates was brought about by email blockage issues rather than flaws in technologically based methodologies or the assumptions of skepticism among email recipients.

In light of the findings within the literature and the results from proactive actions within the aviation faculty study, a systematic means of mitigating email nonresponse is suggested (see Figure 1) and is termed the Ison Email Nonresponse Mitigation System (IENMS). This technique begins with the researcher insuring that they are not using a blacklisted server. While most researchers may assume the email delivery system that they are using is not blacklisted, it is wise to check to insure that email distribution by common survey delivery systems (e.g. Survey Monkey) are not set to be blocked by potential recipients. It was discovered that one particular institution in the aviation faculty survey specifically blacklisted Survey Monkey.

Next is to avoid suspect language, font, and punctuation. For example, avoid all caps, strange fonts, or excessive use of exclamation points or other punctuation. Embedded objects, particularly images and links, should not be used unless absolutely necessary and only when it is assured they will not raise flags with spam filtration software. The inconvenience of having to cut-and-paste a link into a browser outweighs the downside of an email not ever reaching its intended target. Researchers should avoid...
sourcing bulk emails. This can be rather cumbersome, but if it is possible to use an email distribution system that sends emails individually rather than as identifiably bulk delivery, it is critical to do so.

\[\text{Figure 1. The Ison Email Nonresponse Mitigation System (IENMS).}\]
Mitigating Online Survey Nonresponse

The next suggested check for researchers is to insure that they are using a valid email server. While this should not be of concern for individuals sending emails from academic institution servers, one can never be too careful, so verification is suggested. Researchers should also take proactive steps to insure that their emails make it into the inboxes of those they desire to reach. One is to get whitelisted by recipients. This is easy to do when querying individuals that receive their emails from a common source. Examples include if individuals use the same email providers or work at the same institution.

Another important step is to use a non-invasive read receipt system. This allows the researcher to know who has actually received and read the message which is critical for proper response rate monitoring and follow-up procedures. However, caution is in order. When using receipt generators, it is critical that it be tested for its ability to make it through spam filters. Therefore the next step, the testing of the final draft of an email, is perhaps the most important. Some kind of spam detection or testing software should be employed to insure that emails have the highest chance of not being filtered. Finally, researchers should develop an organized means of monitoring response patterns and utilizing read-receipts. This allows them to identify potential threats to the viability of their research and to response rates so that alternative actions can be taken as soon as possible. Only by using these steps can researchers be assured that their study has the highest probably of success.

While the IENMS approaches email based online research utilizing the best practices found within existing literature, the system must be validated through additional research. Furthermore, the IENMS requires active monitoring by the researcher to insure that the desired outcomes are met, i.e. that response rate flows at a reasonable pace and from all types of recipients. Lastly, certain research situations may require amendments or additions to the IENMS to insure the highest achievable participation rate.

Summary

Researchers must be cognizant of all potential influences on their studies which include a variety of errors that can arise throughout the conduct of research. One such obstacle, nonresponse error, is defined by Lindner, Murphy, and Briers (2001) as “people included in the sample fail to provide usable responses,” (p. 44). Therefore if researchers do not insure that they put forth as much effort as possible to collect usable responses from respondents, their research could be subject to this type of error. Moreover, the lower the number of usable receipts, the lower the resultant response rate. The lower the response rate the less credible that research is in the eyes of fellow scholars. Thus it is in the best interest of researchers to simultaneously minimize nonresponse error and to maximize response rate.

The limited amount of literature available concerning this type of obstacle to online research does provide some insight into how to mitigate the effects thereof. With the careful planning of email wording and design as well as the distribution of such messages nonresponse error can be avoided as much as practical. Additional efforts such as testing messages for their likelihood to be identified as spam and careful monitoring of response patterns among email recipients can also mitigate the possibilities of technology-related nonresponse.

In sum, as aviation researchers embrace online techniques for collecting data, care is in order to insure that these individuals are fully aware of the potential consequences of the choice of method of data collection. Much like choosing one type of method of inquiry over another, the positives and negatives must be weighed. Further, researchers must be aware of the potential pitfalls of using a particular method so that they may counter as many of these entanglements as possible.

Recommendations

The findings of this study provide a foundation for further research on the potential effects of spam filtering on online research and how researchers can best circumvent the influences of such technological barriers on their research. Based upon these observations, the following recommendations are made:

1. A formal study on the sending of emails of various forms and formats should be conducted to more accurately measure the negative effects of spam filtration software and how to best counter such effects.
2. An inquiry into the best methods of email wording, design, and distribution should be conducted with respect on how to best mitigate the effects of spam filtering software.
3. A study should be conducted to evaluate the benefits of pre-testing emails for their potential for being blocked by spam filters versus those that are not pre-tested.
4. Further study to validate the Ison Email Nonresponse Mitigation System (IENMS).
David C. Ison completed his bachelor's of aviation management at Auburn University, his master's in aeronautical science, operations specialization from Embry-Riddle Aeronautical University, and his Ph.D. in educational studies, higher education leadership with a sub-specialty in aviation education from the University of Nebraska – Lincoln. David has been involved in the aviation industry for 24 years during which he flew as a flight instructor and for both regional and major airlines. He has experience in a wide variety of aircraft from general aviation types to heavy transport aircraft. While flying for a major airline, David was assigned to fly missions all over the world in a Lockheed L-1011. Most recently, he flew Boeing 737-800 aircraft throughout North and Central America. His true dream was to become an aviation educator which led him to a position as assistant professor of aviation at Rocky Mountain College where he has been working for five years.
Mitigating Online Survey Nonresponse

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Mitigating Online Survey Nonresponse


Mitigating Online Survey Nonresponse


Appendix A

UNIVERSITY OF NEBRASKA-LINCOLN

Department of Educational Administration
141 Teacher College Hall
Lincoln, NE 68588

DATE, YEAR

Joe Pilot
700 Airport Road
Auburn, AL 36830

Dear Dr. Pilot,

A few days from now I will be sending you a request via email to complete a survey. This questionnaire is for an important research project that is being conducted on aviation faculty members like you and me. Within this email, you will be provided with a link to reach the survey which is in an online format. This email will be titled “Aviation Faculty Survey.”

The survey seeks to learn more about aviation faculty teaching at four-year University Aviation Association (UAA) member schools.

Because little research has been conducted specifically on aviation faculty like ourselves, the results of this study will provide critical insights into who aviation faculty are and how they make their way into academics. This study aims to provide a comprehensive analysis of the characteristics and career paths of aviation postsecondary faculty.

As a fellow faculty member, I understand the busy schedule that you face during the school year. This survey is designed to be easy to complete and should take no more than 15 minutes of your time.

Thank you very much for your time in completing this important research study.

Sincerely,
Appendix B

DATE, YEAR

Joe Pilot
700 Airport Road
Auburn, AL 36830

Dear Dr. Pilot,

I am writing as a fellow aviation faculty member to ask for your assistance in a dissertation study of aviation faculty members. This study seeks to learn more about the career and educational pathways that have led such faculty to the aviation professoriate.

I am contacting aviation faculty teaching at four-year University Aviation Association (UAA) member schools. It is my understanding that you are a member of this cohort.

Because little research has been conducted specifically on aviation faculty such as ourselves, the results of this study will provide critical insights into who aviation faculty are and how they make their way into academics. This study aims to provide a comprehensive analysis of the characteristics and career paths of aviation postsecondary faculty.

Please be assured that your responses will be kept confidential. The final results of this survey will be a summary of findings in which no individual responses will be identifiable.

Your participation in this survey is voluntary. However, it would be extremely beneficial if you could share your experiences about your path into the aviation professoriate. If you do not want to participate, please respond via email stating that you would like to abstain from completing the survey.

To enter the survey please click on the following link: http:// surveymonkeylink

If you should have any questions or comments about this study, I would be very interested in talking to you. Please do not hesitate to write to the address on the letterhead above, call XXXX or email link.

Thank you very much for participating in this important study.

Sincerely,
Appendix C

University of Nebraska - Lincoln
Department of Educational Administration
141 Teacher College Hall
Lincoln, NE 68588

Dear Professor XXXXX,

About two weeks ago you received an email about an upcoming aviation faculty survey. This survey was sent out Monday of last week. Unfortunately, some university/college email systems treated the message as Spam and/or placed it in a Junk folder.

I truly need your assistance in completing this survey. Your inputs are highly valued. Therefore I can offer several options to take the survey if you are interested in helping further research on aviation faculty like you and I.

Option 1:
Go to www.aviationfacultysurvey.com
This site has a link to the survey.
The password to enter the survey is 4321.

Option 2:
I can make an appointment to call you and we can complete the survey on the phone.
Please reply to this email if you would like to take the survey in this manner.

Option 3:
I can mail you a paper copy for you to complete at your leisure.
Please reply to this email if you would like to take the survey in this manner.

Thank you so much for your time! I look forward to receiving your inputs and responses.

If you have any questions, feel free to reply to this email.

Sincerely,