Survey on the Fate of Digital Footprints after Death

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***Abstract*—When we die, we leave imprints of our online lives behind. What should be the fate of these digital footprints after our death? Using a crowdsourced online survey with 400 participants from four countries, we investigate how users want their digital footprint handled after their death, how they would like to communicate these preferences, and whom they would entrust with carrying out this part of their will.**

We poll users' sentiments towards an online service curating digital footprints. We let users comment on design questions regarding this service posed by Locasto, Massimi, and De Pasquale (2011, NSPW). Interestingly, responses across countries and religions were similar. The vast majority of participants had never considered the fate of their digital footprint. When faced with the choice, our participants request a non-profit service primarily for deleting their accounts upon receiving a death certificate.

I. Introduction

Throughout our lives, we accumulate various online accounts, contribute to blogs and wikis, and engage in social networks. When we die, this digital footprint remains—alongside several unresolved questions: What should happen with our digital footprint? Which traces of our online lives should be deleted, conserved, inherited, or treated otherwise? Who should we entrust with handling our digital footprint according to our will? How would we like to communicate our will to our followers or to our online-only friends? Would we like to be mourned online and, if so, how and where?

While this subject is increasingly discussed in academic circles, little is known about what end-users really want with respect to their digital death. Currently, we lack policies and systems to help users arrange the retirement of their accounts or the inheritance of their digital belongings. Any potential solution for this complex matter can only be successful if the privacy, security, and ethical challenges surrounding its design are resolved in alignment with the users' preferences.

Our contribution consists of the first survey on this topic in which we poll 400 participants from the United States, Great Britain, India, and a selection of Asian countries. Through a crowdsourcing survey, we inquire which fate our participants intend for their digital footprints when they die. We investigate which online services participants would use to prepare for the eventuality of their death and how they feel about a unified service curating their digital footprints after their death. Finally, we collect our participants' experiences with handling the digital footprint of a deceased, receiving automated messages from a deceased, and mourning online.

Some differences emerged based on country or religion, but overall participants expressed similar attitudes. We find that the majority of our participants would want their digital footprint to be deleted, or handed to their next of kin. When asked about different account types, participants express clear preferences, again favoring deletion—even for their contributions to collaboration platforms. We ask participants which features of death-related online services they would use and who should be entrusted with operating these services. Our participants would like an online service for deleting accounts that acts upon receipt of a death certificate and should be run by a non-profit organization. This deviates from the features offered by existing online services, many of which are for-profit and prompt for liveness on a regular basis. Our results provide insight into how the privacy and security issues surrounding this sensitive topic are viewed by end-users.

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USEC '14, 23 February 2014, San Diego, CA, USA
Copyright 2014 Internet Society, ISBN 1-891562-37-1
http://dx.doi.org/10.14722/usec.2014.23049

II. Related Work

The questions surrounding the fate of digital footprints after death are gaining increasing attention in both academia and the general public. The topic is covered in books [2], magazines [3], webcomics [4], scientific workshops [1], [5], conferences and journals [6] alike. The matter is discussed in new dedicated workshops such as Memento Mori [5] and (un)conferences such as the Digital Death Day.[1] On the other hand, many companies and institutions hosting our accounts—and thereby the various pieces of our digital footprint—are often hesitant to address the matter or create policies and mechanisms for gracefully retiring our accounts when we die [1].

Walter, Hourizi, Moncur, *et al.* [6] summarize various forms of grieving online and compare them with traditional forms of mourning. Mori, Gibbs, Arnold, *et al.* [7] analyze how online platforms like MySpace and YouTube served as spaces to commemorate US teen Anna Svidersky after she was murdered.

Several websites for mourning online, sending pre-written messages upon death, and other online services related to preparing for death have emerged in the past few years. Many of them are, however, short-lived: eight of 18 services listed by Carroll and Romano [2] in 2010 have already vanished.

[1] digitaldeathday.com/about

Locasto, Massimi, and De Pasquale [1] propose a cloud-based unified service managing access to all of a client's accounts during their lifetime and allowing them fine grained control over account inheritance. Locasto, Massimi, and De Pasquale [1] kindle a debate about the specifics of this unified service, e.g., its business model and its deployment method. In our study, we invite the users to this debate.

We are aware of one other survey study on users' preferences for handling digital footprints after death. Maciel and Pereira [8] investigate how religious beliefs of Brazilian high-school students influence how they would like their social media profiles treated when they die. Maciel and Pereira [8] find that their participants desire settings allowing them to choose which parts of their profile should be deleted, turned into a memorial page, or treated otherwise.

III. Methodology

In this section, we describe the design of this study including the research objectives, the structure of the questionnaire,[2] the recruitment process using CrowdFlower,[3] potential risks for participants, pilot tests, and limitations of this study.

A. Research Questions

With this survey study, we seek answers to the following questions regarding users' preferences and sentiments:

- Q1) Are users concerned about preparing their digital footprint for the eventuality of their death?
- Q2) Are users familiar with death related online services?
- Q3) What are the preferred ways of handling digital footprints after death?
- Q4) How should preferences about handling of digital footprints be communicated?
- Q5) Who should be the executor responsible for handling digital footprints?
- Q6) Which institution should run a unified service?
- Q7) Which features do participants require for preparing their digital footprint for death?
- Q8) How should a unified service assert and verify the death of a client?

Furthermore, we seek to learn which experiences users had with handling the digital footprint of a deceased, receiving automated messages from a deceased, and mourning online.

B. Structure of the Questionnaire

During the study, participants fill out a questionnaire that is broken into three parts: demographics, preferences, and experiences. In demographics, we collect information about our sample population. In preferences, we ask participants how their digital footprint should be handled when they die and gather their sentiments and thoughts about a unified service and its features. In experiences, we invite participants to share their experiences regarding handling accounts of a deceased, receiving messages from a deceased, and online mourning.

[2]The full questionnaire of this study can be found in the appendix of the corresponding technical report [9].

[3]www.crowdflower.com

For demographics, we collect the participants' gender, age, education, occupation,[4] and religion. We ask participants how many online accounts they have, which gives a crude estimate of the size of their digital footprint. This question might also help participants refresh their memory of their online accounts.

In the preferences part of the questionnaire, we inquire how digital footprints should be handled after death. More precisely, we address the following topics:

1) We ask participants how important they perceive preparing for their death and, more specifically, how important they perceive preparing their digital footprint for their death.
2) We ask how their digital footprint should be handled in general and then repeat this question for specific types of accounts such as e-mail, social media, and dating.
3) We ask which types of death related online services participants know. We name none of the existing services, since we cannot vouch for their trustworthiness and, thus, would like to avoid advertising them. Introducing the different types of these services prepares the participants for the questions on the unified service proposed by Locasto, Massimi, and De Pasquale [1].
4) We let participants rate their approval for five types of organizations as providers of a potential unified service. The offered organization types are national government, provincial government, municipal government, for-profit companies, and non-profit organizations. In our pilot studies, many participants expressed indifference on 5-point Likert scales. Therefore, we use 6-point Likert scales to capture mild approval or disapproval.
5) We ask which features of a unified service participants would use or consider useful to others.
6) We ask who should be entrusted with running a unified service and how it should assert the death of a client. Participants rate whether a potential unified service would be appropriate, useful and realistic.
7) Finally, participants can comment on a unified service.

The experiences part of the questionnaire consists of three sections addressing experiences with handling the accounts of a deceased, receiving an automated message from a deceased, and mourning online. Due to its sensitive nature, all sections are optional and only shown when participants agree to share their experiences. In the first section, we inquire about the tasks performed on behalf of the deceased (e.g., deleting accounts, preparing an online memorial). For different types of websites, we ask whether participants were successful, successful with difficulties, or unsuccessful in carrying out these tasks. In the second section, we ask how participants perceived a message that they received from a deceased, i.e., whether it was disturbing or comforting. In addition, we ask which online service delivered the message. In the last section, we ask where the online memorial took place, who organized it, and how the memorial was received. Each section ends with a text field for free form comments.

[4]The answer choices for this question are taken from an online survey by Bravo-Lillo, Komanduri, Cranor, *et al.* [10].

The questionnaire is composed using the CrowdFlower Markup Language and hosted on the CrowdFlower platform. We use customary elements such as radio buttons for multiple choice questions, checkboxes for question with multiple possible answers, text fields for answers in free form, and Likert scales for ratings. Unless stated otherwise, we use 5-point Likert scales to provide participants with a neutral answer.

C. Recruitment via CrowdFlower

Using CrowdFlower[2] as a broker, we recruit participants from crowdsourcing marketplaces such as Amazon's Mechanical Turk,[5] NeoBux,[6] and CliXSense.[7] In these marketplaces, workers perform little jobs such as tagging photo content, editing text, and completing surveys. Workers chose which jobs to perform and are paid a few cents per job, earning between $1.50 and $2 per hour [11]. While the demographics of workers from Mechanical Turk are well studied [11], [12], little is known about workers from the various other marketplaces. We rely on CrowdFlower for this study, since it is—unlike Amazon's Mechanical Turk itself—available for researchers outside of the United States and reaches more workers.[8]

CrowdFlower serves as a recruitment agency for other crowdsourcing marketplaces, handling job posting and worker payment. CrowdFlower rates workers according to three skill levels (3 = best) based on their performance in previous jobs and on assessment jobs (e.g., jobs testing language proficiency). For our survey, we admitted only workers of skill level 2 or higher, due to bad experiences with level 1 workers during pilot testing. A risk of crowdsourcing studies is that some participants may try to fill out the questionnaire rapidly or multiple times to maximize their profit. These participants are likely to put less thought, if any, into their answers. During our pilot studies, participants took at least 5 minutes to read through all questions without answering them. Based on this, we required participants to spend at least half this time, i.e, 150 seconds, on the questionnaire. To further deter dishonest participants, we blocked multiple answers from the same IP, let CrowdFlower track aliases across the various online workplaces, and allowed only participants whose accounts have been active for at least one month. Together with requiring at least level 2 participants, these countermeasures seemed sufficient and less intrusive for honest participants than, for instance, repeated questions or elaborate trick questions [13].

Since we expected the answers to our questions to vary by culture and religion, we selected participants from different countries to put our expectations to a test. We requested 100 participants from each the United States, India, Great Britain, and Asia (Vietnam, Philippines, Thailand, Laos, Indonesia, and Singapore). Originally, we requested participants from Germany, Egypt and Brazil as well, but retracted these requests after a few days of inactivity in favor of Vietnam and Great Britain, respectively. After further inactivity we combined Vietnam with other countries of the region to the Asia category. For our initial selection of countries, we selected the country with the largest number of internet users on its respective subcontinent. It remains an open question whether the number of internet users was a poor indicator of crowd worker activity or whether the topic of the survey is considered taboo in these countries.

[5] www.mturk.com

[6] www.neobux.com

[7] www.clixsense.com

[8] When this study was conducted, CrowdFlower was offering access to Amazon's Mechanical Turk as one of many crowdsourcing marketplaces. Shortly after this study ended, CrowdFlower terminated this cooperation.

D. Risks and Benefits for Participants

After accepting the job, participants are shown the consent form informing them about the purpose of the study and their rights. Filling out the survey takes about 20 minutes and participants who complete the survey receive a payment of 50 US cents. The survey collects no sensitive information and participants remain anonymous. Participants can withdraw from the survey at any time and can always opt to skip a question should they feel uncomfortable answering it.

The study design was reviewed and approved by the Research Ethics Board of Carleton University.

E. Pilot Tests

We asked three colleagues to review the instructions, the consent form and the questionnaire for clarity and appropriateness of language. Two of these colleagues were native English speakers. We performed a sequence of small pilot tests to familiarize ourselves with the CrowdFlower platform. From these pilot tests, we found some answers from level 1 workers dubious (e.g., "Airplane Banner!" or other random strings in the free form comment fields). In response, we requested level 2 workers for the actual study.

F. Limitations

Due to a typo, the question asking participants to rate organization types for their suitability as a hosting agency of a unified service was flawed. We corrected this error after one participant brought it to our attention; only 178 of the 400 participants answered the corrected question.

Due to our selection of countries, the distribution of religions is skewed towards Christianity, Hinduism, and Atheism compared with the world distribution of religions [14]. The distribution of occupations was skewed towards unemployed, science, and business. The participants in our sample seem rather young with no participants above the age of 70; the topic of death may be less relevant to younger users, while their footprint may be larger compared to older users.

While we chose the order of questions carefully to avoid influencing participants, providing answers in multiple choice form might have affected participants' responses. In particular, fixed choices might dissuade participants from searching for their own answers. Furthermore, permuting answers would be preferable to presenting them in a fixed order. However, CrowdFlower offers no support for this feature at this time.

Only a small fraction of our participants shared experiences in the third part of the survey. This could be because few participants had such experiences or because participants

perceived these experiences too personal to be shared in a survey. Collecting such experiences might require a dedicated survey or a user study in an interview format.

IV. Analysis

In this section, we summarize our participants' demographics and analyze their survey responses. We perform statistical tests to identify significant patterns in user preferences in the answers from the preferences part of the questionnaire. Where appropriate, we further check whether these patterns differ by country or religion. All statistical tests are done with SPSS version 22 assuming a significance level of $p < 0.05$.

A. Demographics

Over the course of 7 days, the survey was made available to a variety of crowsourcing channels. It collected responses from 400 participants with 126 from NeoBux, 98 from ClixSense, 42 from each of Prodege[9] and instaGC,[10] and 92 from other platforms. Only two participants were from Mechanical Turk. The participants were divided into seven nationalities: 100 were from each the United States, India, and Great Britain. Among the participants from the Asian countries, 45 were from the Philippines, 42 were from Indonesia, 12 were from Vietnam, and one participant was from Thailand. For the sake of simplicity, we refer to the countries from Asia as one group.

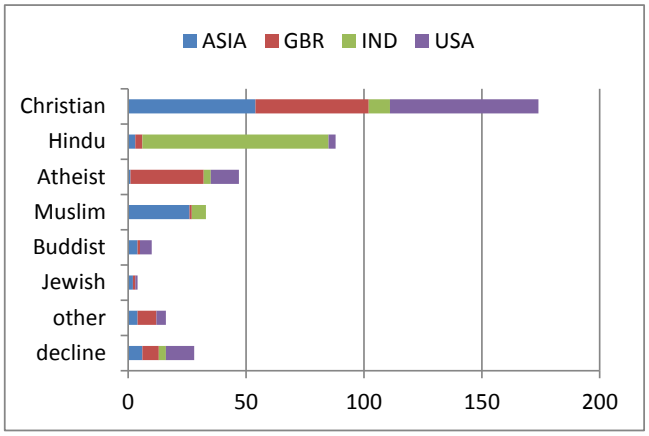


Figure 1. The distribution of religions by country.

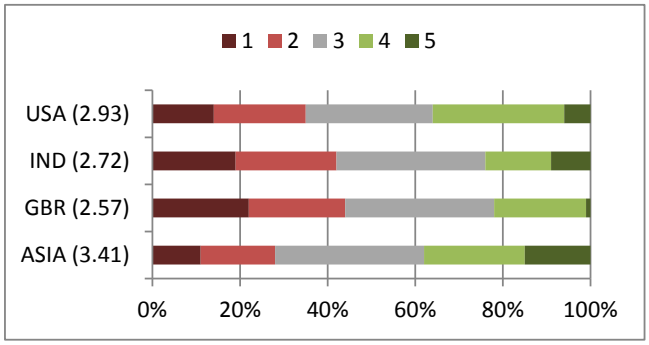
Given that the subject matter may be viewed differently by various populations, we provide a detailed demographic breakdown to help with interpretation. In total, 176 participants were female (44.00%), 215 were male (53.75%), and 9 declined to answer (2.25%). The participants' ages range from 18 to 69 with mean 34.78 and standard deviation 10.80. Participants' religious affiliations are summarized in Figure 1. For statistical tests, we group religions with less than 20 participants (5%) into one group labeled "other". The rare religions in our sample are Buddhist (10), Jewish (4), and other (16). In the appendix, we summarize the distributions of genders (Figure 11), age (Figure 12), and occupations (Figure 13).

[9]www.swagbucks.com
[10]www.instagc.com

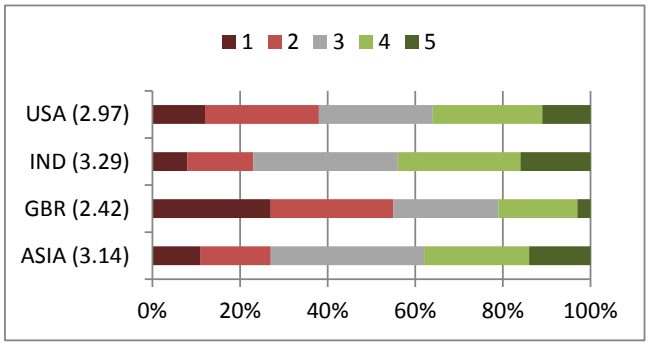
B. Importance of Preparations for Digital Death (Q1)

Using 5-point Likert scales with labels from 1 = very irrelevant to 5 = very relevant, participants rated the importance of preparing for their death and preparing their digital footprint for this eventuality given their current stage of life.

Overall, participants displayed a wide range of responses about the relevance of preparing for death in general (mean = 2.84, std = 1.174) and for preparation of their digital footprint (mean = 2.95, std = 1.213). We further examined responses for patterns based on country or religion. Figures 2 and 3 show the respective ratings per country and per religion.



(a) Relevance of preparing for death in general by country.

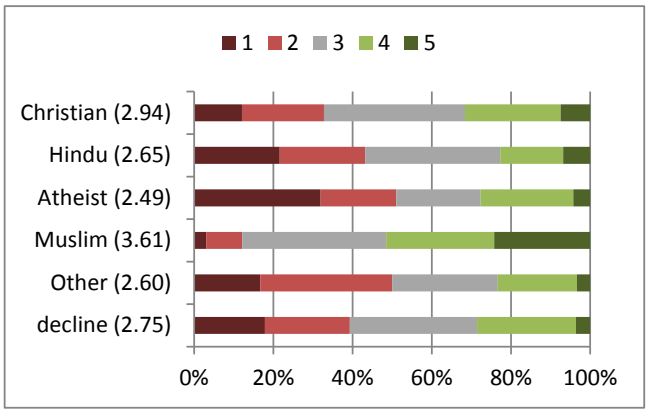


(b) Relevance of preparing digital footprints for death by country.

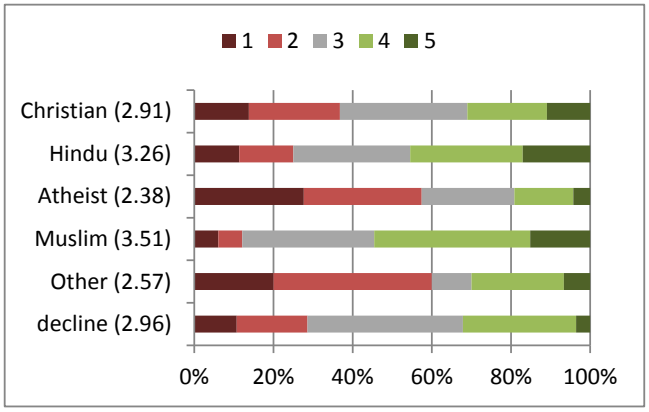
Figure 2. Relevance for death preparations rated on a 5-Point Likert scale (from 1 = very irrelevant to 5 = very relevant). The numbers in the parenthesis indicate the means.

Country: We found statistically significant differences between countries on the subject of preparing for death in general (Kruskal-Wallis test: $n = 400$, $\chi^2(3) = 12.585$, $p = 0.006$). Pairwise comparisons using Dunn's method identify a significant difference between Great Britain and Asia but no other significant differences.

Similarly, we found overall differences between countries on the subject of preparing digital footprints for death (Kruskal-Wallis test: $n = 400$, $\chi^2(3) = 28.542$, $p = 0.000$). Pairwise comparisons using Dunn's method show that participants from Great Britain were significantly less concerned than those from the United States, Asia, and India.



(a) Relevance of preparing for death in general by religion.



(b) Relevance of preparing digital footprints for death by religion.

Figure 3. Relevance for death preparations rated on a 5-Point Likert scale (from 1 = very irrelevant, 5 = very relevant). The numbers in the parenthesis indicate the means.

Religion: Overall statistically significant differences were found between religions with respect to the importance of preparing for death in general (Kruskal-Wallis test: $n = 400$, $\chi^2(5) = 21.848$, $p = 0.001$). Muslims had the highest mean score and Atheist had the lowest. Pairwise comparisons show that Muslims are significantly more concerned with preparing for death than Atheists, Hindu, and Other religions.

Overall significant differences were found between religions with respect to specifically preparing their digital footprint for death (Kruskal-Wallis test: $n = 400$, $\chi^2(5) = 27.145$, $p = 0.000$). Based on means, Muslims showed the highest degree of concern and Atheists were least concerned; the difference between this pair was statistically significant. However, pairwise comparisons using Dunn's method revealed no consistent patterns among the other religions.

In response to Q1, we find mixed results, with responses across the full spectrum of possibilities. Both preparing for death in general and preparing digital footprints are slightly less relevant to participants from Great Britain than to participants from other countries. We also note that while Muslims are most concerned with preparing for death in general, no consistent differences were found between religions in the perceived importance of preparing their digital footprint.

C. Familiarity with Death Related Services (Q2)

As shown in Table I, the majority of our participants were unfamiliar with online services related to death, i.e., sending automated messages upon death, online memorial services, automatic account inheritance, and automatic deletion of accounts upon death. Only four participants claimed to have tried or claimed to use any of the listed services. To the best of our knowledge, there is no service for automatic account inheritance; the only participant who claimed to have tried such a service declined to specify its name. Given the small number of participants familiar with these services, we did not conduct further analysis by country or religion.

	E-Mail upon Death	Online Memorial	Inheriting Accounts	Deleting Accounts
using	0	1	0	1
tried	0	1	1	1
looked	14	23	28	30
heard	100	150	83	94
not heard	286	225	288	274

Table I
NUMBER OF PARTICIPANTS (OUT OF 400) WHO WERE FAMILIAR WITH PARTICULAR ONLINE SERVICES RELATED TO DEATH.

D. Handling Digital Footprints after Death (Q3)

Participants gave a general response for how their entire digital footprint should be handled when they die. Figure 4 shows their preferences. Overall, we see a strong preference for deleting accounts, handing accounts to next of kin, and deciding individually for each account.

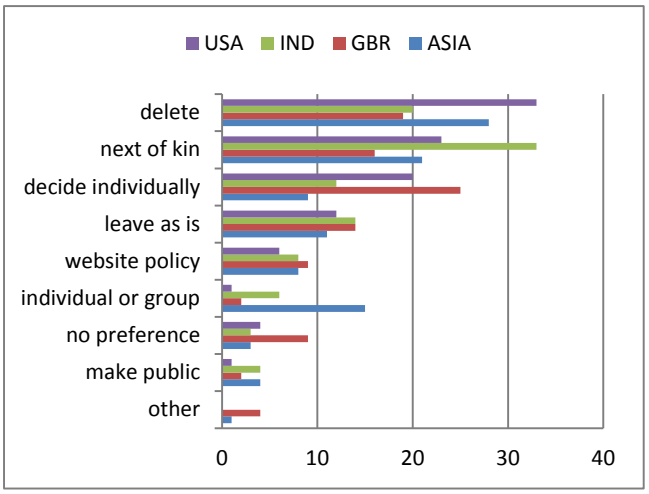


Figure 4. Responses for how participants want their general digital footprint to be handled by country.

Country: With respect to how digital footprints should be handled after death, we found significant differences between countries according to Pearson's Chi-square test ($n = 400$, $\chi^2(24) = 59.428$, $p = 0.000$). Participants from the United States and Asia preferred deleting accounts, participants from India preferred handing accounts to their next of kin, and participants from Great Britain preferred deciding individually.

Religion: We found no significant differences by religion for how digital footprints should be handled after death.

We repeated the question for several types of accounts to get further information on participant preferences. Table II shows participants' most common answers for different account types. As expected from the general results, participants primarily wish to delete individual accounts or hand them over to their next of kin. Bank accounts clearly should be given to next of kin, while chat, dating, and gambling accounts clearly should be deleted. Other account types had more varied responses. Interestingly, a surprising number of participants would want their blogs and contributions to collaborative websites to be deleted when they die. We expected a stronger preference towards leaving these available for historical purposes.

Account Type	Option	# Participants
Social Media	delete	167
	next of kin	68
	leave as is	68
Banking	next of kin	229
	delete	95
E-Mail	delete	187
	next of kin	106
Chat	delete	260
	leave as is	43
Cloud	next of kin	154
	delete	123
Entertainment	delete	162
	next of kin	99
	leave as is	48
Blog	next of kin	126
	delete	91
	leave as is	72
Collaboration	delete	103
	leave as is	89
	next of kin	73
	no preference	43
Shopping	delete	185
	next of kin	117
Dating	delete	284
Gambling	delete	268
	no preference	45
Pictures	next of kin	198
	delete	59
	leave as is	55
Government	delete	149
	next of kin	138

Table II
PREFERENCES FOR HANDLING ACCOUNTS BY TYPE. ONLY OPTIONS CHOSEN BY AT LEAST 40 OF THE 400 PARTICIPANTS (10%) ARE SHOWN.

E. Communication of Digital Will (Q4)

We asked participants to choose how they want to communicate preferences with regards to handling their digital footprints. Overall, our participants prefer to use personal communication and account settings to convey their will in this regard. The distribution of answers, as illustrated in Figure 5, show clear preferences according to Cochran's Q test ($n = 400$, $\chi^2(8) = 506.018$, $p = 0.000$). A pairwise comparison of the options using McNemar's test yields the clusters {personal communication, account settings} > {conventional will, message from grave, no preference} > {blog announcement, memorial online service, dedicated service} > {other}. The item "dedicated service" refers to the answer option "dedicated online service managing access to my accounts". Items within the same cluster have no significant differences; items in different clusters differ significantly from each other.

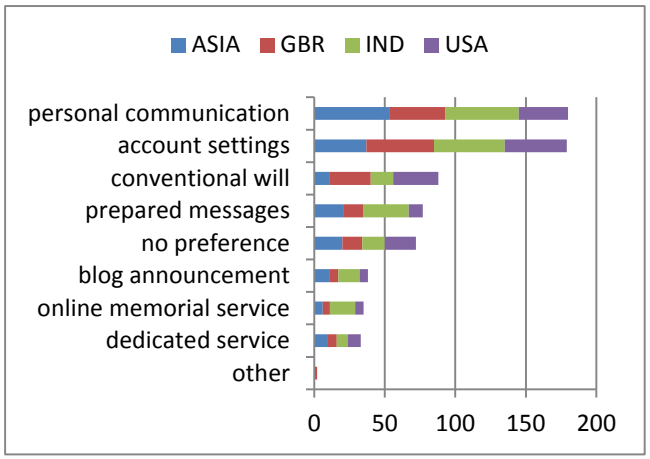


Figure 5. Preferred communication methods for conveying how digital footprints should be handled. Multiple responses were allowed.

F. Executor of Digital Footprint (Q5)

Participants stated who they would entrust with handling their digital footprint after their death. Figure 6 shows the distribution of participant answers, indicating a clear preference for "next of kin or friends". Differences between options are significant according to Cochran's Q test ($n = 400$, $\chi^2(10) = 674.170$, $p = 0.000$). A Pairwise comparison using McNemar's tests identifies "next of kin or friends" as the preferred option, but shows no consistent patterns for the remaining answers.

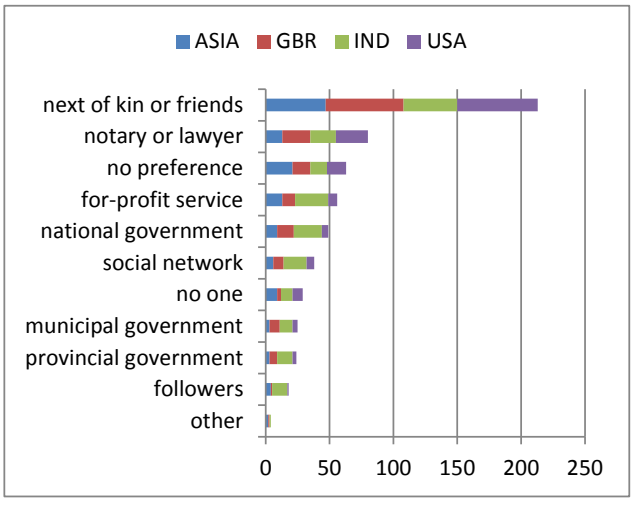


Figure 6. Chosen executor entrusted with handling digital footprint after death. Multiple responses were allowed.

G. Providers of a Unified Service (Q6)

In the first question regarding a unified service as proposed by Locasto, Massimi, and De Pasquale [1], participants rate potential providers of such a service on a 6-point Likert scale. During the study, one of the participants notified us about a typo in the labels of these ratings. Only the 178 participants who saw the corrected question are considered in this analysis. Of these 178 participants, 91 were from the group of Asian countries, 37 were from Great Britain, 25 were from India, and another 25 were from the United States.

The participants' ratings are depicted in Figure 7 and the mean ranks are listed in Table III. We see a significant preference for non-profit organizations with for-profit companies being the least well accepted option and this pattern is consistent throughout countries and religions.

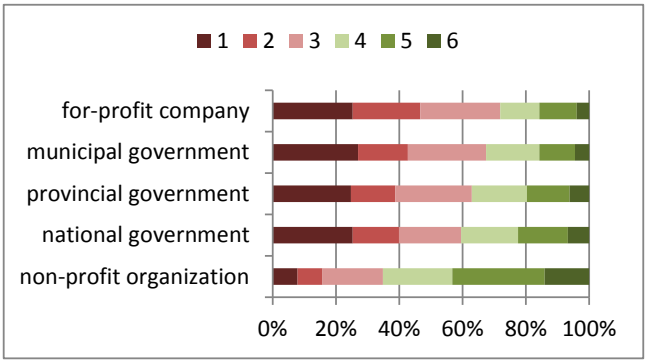


Figure 7. Ratings for potential providers of a unified service on a 6-point Likert scale (from 1 = strongly disagree to 6 = strongly agree).

Organization Type	Mean Rank	z
For-Profit Company	2.63	-7.904
Municipal Government	2.67	-7.060
Provincial Government	2.91	-6.289
National Government	2.95	-5.930
Non-Profit Organization	3.84	—

Table III
MEAN RANKS OF RATINGS FOR PROVIDERS OF A UNIFIED SERVICE. THE z VALUE IS FROM WILCOXON SIGNED RANK TESTS AGAINST RATINGS FOR NON-PROFIT ORGANIZATIONS (EACH $n = 178$, $p = 0.000$).

Friedman's Two-Way Analysis of Variance by Ranks confirms the difference in ratings ($n = 178$, $\chi^2(4) = 114.026$, $p = 0.000$) and all pairs Wilcoxon's signed rank tests, shown in Table III, confirm a significant different between non-profit organizations and the other organization types.

H. Desired Features of a Unified Service (Q7)

Participants selected which death-related online services they would use. Users could select multiple responses and Figure 8 summarizes their answers. Apart from "other", each option was selected by at least 88 participants (22%). While our participants dismiss none of the proposed services, they show a strong preference for a service deleting accounts.

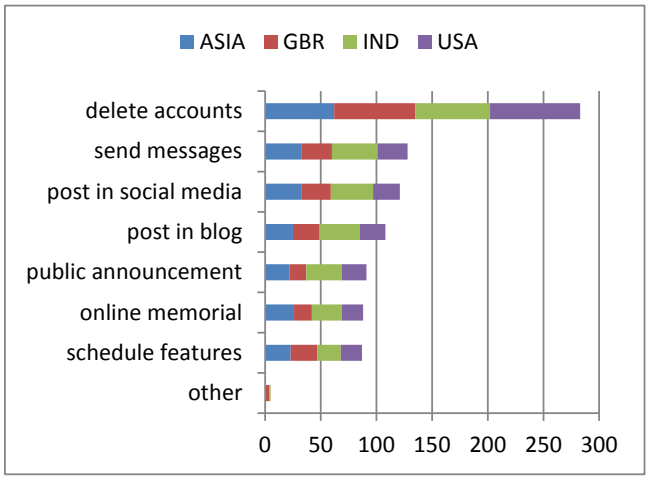


Figure 8. Desired features of a unified service.

Cochran's Q test ($n = 400$, $\chi^2(7) = 572.713$, $p = 0.000$) confirms differing ratios between choices and pairwise McNemar tests identify a significant preference for deleting accounts over all other choices, but no significant difference between the remaining choices except for "other". No significant patterns were apparent between countries or religions.

I. Determining Death (Q8)

Participants indicated how a unified service should assess the death of a client. The options included that the service could wait for receipt of a death certificate, work directly with the institution issuing death certificates, prompt clients to respond to keep-alive messages at regular intervals, or monitor activities across all accounts and interpret inactivity as death.

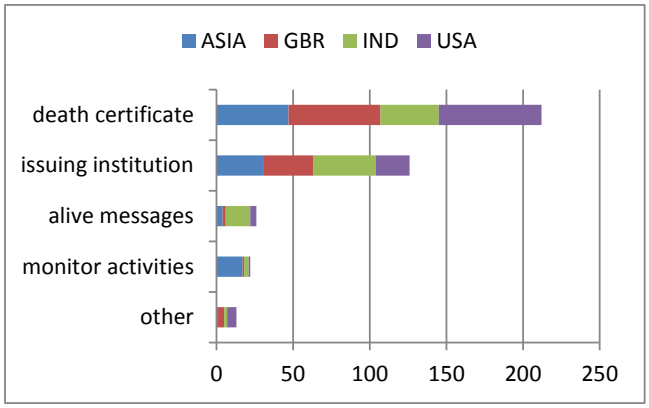


Figure 9. Preference for how a unified service should assess the death of a client.

Figure 9 shows that participants prefer that the unified service receives death certificates before taking action, followed by working together with the institution issuing death certificates. The differences are significant according to Cochran's Q test ($n = 400$, $\chi^2(4) = 379.810$, $p = 0.000$). Pairwise McNemar tests show a clear preference for death certificate over all options and a preference of working with the issuing institution over the remaining options.

Countries: Pearson's Chi-square test shows significant differences by country in preferences for how death should be determined ($n = 400$, $\chi^2(12) = 71.619$, $p = 0.000$). All countries prefer the use of death certificates except for India, where death certificate and working with the issuing institution are equally acceptable.

Religion: Pearson's Chi-square test shows significant differences by religion in preferences for how death should be determined ($n = 400$, $\chi^2(20) = 47.093$, $p = 0.001$). Christians and Atheists clearly prefer the use of death certificates. Muslims and Hindu view death certificates and working with the issuing institution as equally acceptable. We refrain from commenting on the "other" and "decline to provide a religion" groups since they do not represent religious entities.

J. Sentiments regarding a Unified Service (Q7)

Figure 10 shows the participants' ratings for whether they consider a unified service realistic, useful, and appropriate. Differences by country were significant for appropriateness (Kruskal-Wallis: $n = 400$, $\chi^2(3) = 24.956$, $p = 0.000$) Pairwise comparisons using Dunn's method showed that Indians considered the service more appropriate than others ($p = 0.000$ vs. GBR, $p = 0.003$ vs. USA, and $p = 0.003$ vs. Asia). Differences by religions were significant, but the pairwise comparisons revealed no consistent pattern. Overall, the ratings indicate a general approval of the proposed service.

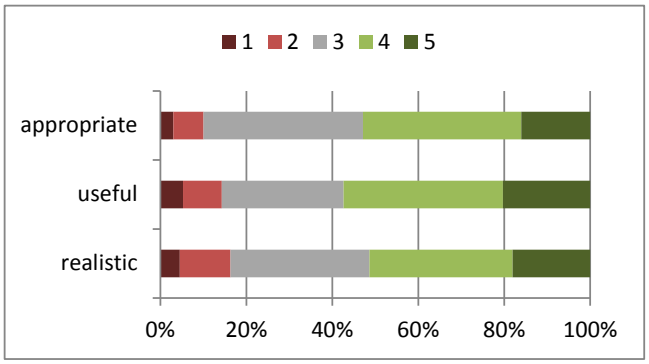


Figure 10. Ratings for sentiments about a unified service on 5-point Likert scales (from 1 = very unrealistic / useless / inappropriate to 5 = very realistic / useful / appropriate).

K. Open-ended feedback

At the end of the preferences section, participants could share their thoughts on a unified service in free form comments. We summarize a few common themes in the answers without claiming statistical significance.

Usefulness: Many participants gave positive feedback describing the idea as "innovative" and "very helpful". Only few participants indicated that they considered the topic irrelevant ("Who cares after you're dead?"). Instead, several described the topic as relevant, yet difficult: "I need to give it some thought, but not today—it's depressing me!", "I have never considered using a service like this—until today. I'm going to look into this. I don't want my family or next of kin to view my social media accounts.", "It's a little morbid but worthy of thought."

Others had previously wondered about the issue of digital death and see the benefit of such a service. One participant explains: "I have a chronic illness and spend a lot of time online and have thought about the fact that my spouse and family need to know about certain accounts that I have online and I have tried to share with my spouse which sites may have monies or information that would benefit him. But if we were both to die I am not sure that my children would know of these accounts. So I do think that this idea is a good one".

Practicality: Some participants expressed concerns regarding the implementation of a unified service ("No idea how such a thing could be secure, policed, organized or accurate.","people might not be willing to pay for it or trust the business offering the service."). Other participants acknowledged the challenges surrounding a unified service, albeit emphasizing their low tolerance for mistakes: "This seems to be a very big project if it were to become realistic, so it should be done right the first time. Mistakes do happen, but there should be no mistakes with this kind of service."

Appropriateness: Some found it "incredibly inappropriate". For example, regarding the means of verifying a client's death, one participant stated "Sending people emails asking if they are still alive is entirely inappropriate" while another remarked that "they certainly should not assume death". Likewise, many participants stressed that "privacy and accuracy are a must" and expressed concerns about potential abuse: "I think that it has to be very rigorous in the first place of establishing a death and verifying that it has indeed taken place, particularly with malicious usage of the web, trolling and [identity theft]".

Replacement for traditional wills: Some participants preferred traditional wills and having their relatives handle their footprint through existing methods (which potentially violate terms of service [1]). On the other hand, at least one participant expected that a unified service could replace traditional wills: "This will remove the hassle of making traditional will, [and using a] lawyer and court registration".

L. Experiences

We omit the analysis of the last part of the survey, since very few participants shared their experiences with handling accounts on behalf of a deceased (31), receiving an automated message from a deceased (21), or online memorials (16). With fewer than 10% of respondents commenting on their experiences, we leave this exploration to future work.

V. Discussion

Our study provides insight into how participants from different countries and religious backgrounds view the topic of digital death. Participants favored a unified system managed by a non-profit organization and primarily wanted the system to delete accounts or delegate them to specified next of kin or friends. Death is a universal topic and there were more commonalities between groups than we initially expected. Some notable differences were also apparent.

Preparing ones' digital footprint for death was most irrelevant to participants from Great Britain, while participants from the United States and Asia were indifferent. Participants' awareness of death related online services and interest in these services seems rather low with online memorials being most well known. This may be because these services are still rather novel and have yet to gain acceptance of the general public.

We had expected participants' preferences for the fate of their digital footprint to vary more strongly. To our surprise, there seemed to be an agreement on certain scenarios for handling digital footprints across countries and religions. First, the majority of participants stated that they would like to have their digital footprint deleted, which is consistent with account deletion being the most requested feature in a unified service. Second, another large portion of our participants would like to entrust their next of kin with their digital footprints when they die. Third, many participants stated that they would like to decide individually how each part of their footprint should be handled when they die. This is consistent with the variability in preferences for different account types and, perhaps, with many participants opting to set individual account settings for communicating their preferences. Personal communication was the other preferred communication method for conveying participants' will regarding the fate of their digital footprints.

Death is a topic that is infrequently considered by most younger populations. Given that our participants were rather young (mean age = 34.78 years), many had not yet considered plans for their eventual death and were not especially concerned about dying. While understandable, the facts remain that these users have an increasingly large digital footprint and that the issues raised in this paper will become increasingly important. Many younger participants will have decades of online data accumulated by the time that they die. While procedures are in place for other aspects of our lives, there is currently no real way of managing our digital footprint.

For many in our study, this was the first time that the problem of digital death was brought to their attention. This is likely also the case for the general population. A unified service would need considerable marketing and educational campaigns to raise awareness and acceptance.

We gather that our participants want a unified service run by a non-profit organization assessing the death of a client by receiving death certificates or working with the institution issuing these certificates. This differs from many of the existing services run by for-profit companies which prompt users regularly to confirm that they are still alive. In fact, prompting for liveness was viewed quite negatively by our participants.

According to our participants, the primary function of a unified service should be the deletion of accounts followed by other features such as sending messages to selected individuals or offering a space for online memorials as secondary functions. The majority of our participants had a positive view of a unified service with only a few considering it inappropriate, useless, or unrealistic.

A crowdsourcing survey enabled us to collect a large number of responses from different countries and provided an overview of the issues and users' sentiments. Future work includes conducting interviews to collect explanations for the observed patterns from a smaller group of participants. For instance, we could inquire about the reasons why so many participants would want their digital footprint to be deleted. We could also probe further about desired functionality and the acceptability of different designs.

VI. Conclusions

We perform the first crowdsourced online survey asking how digital footprints should be handled after death. We find that most users want their digital footprint to be deleted, inherited to their next of kin, or handled individually depending on the account type. We gather users' sentiments towards a unified service [1] handling accounts and data on behalf of a deceased.

We find that, contrary to most existing death related online services, a unified service should be run by a non-profit company confirming the passing of a client by means of death certificates. With this survey, we provide some insights into how users respond to some of the open design challenges stated by Locasto, Massimi, and De Pasquale [1].

Given the sensitive nature of digital death, any system will need an extremely careful design that respects cultural, religious, and personal boundaries while ensuring utmost privacy and security. As mentioned by a participant, there is no room for error when dealing with digital death.

Acknowledgments

We would like to thank Gregory Bint, Matthew Eastman, and André van Renssen for their feedback on the questionnaire. We are indebted to Pauline Adams for pointing out a flaw in one of our rating questions. Finally, we thank the anonymous reviewers for their helpful feedback and comments.

Sonia Chiasson holds the Canada Research Chair in Human-Oriented Computer Security and acknowledges NSERC for funding the Chair. Carsten Grimm was kindly supported by a fellowship from the German Academic Exchange Service.

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APPENDIX

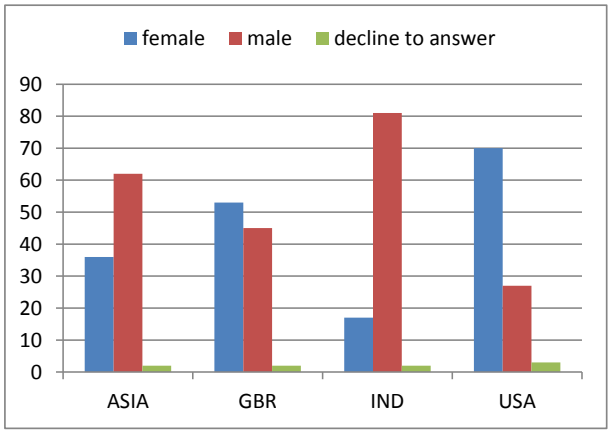

Figure 11. The gender distribution by country.

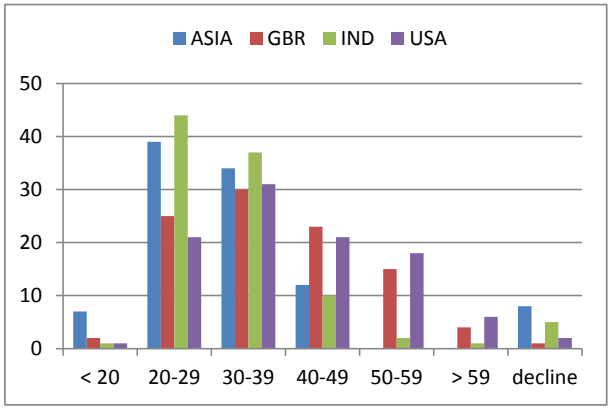

Figure 12. The age distribution by country.

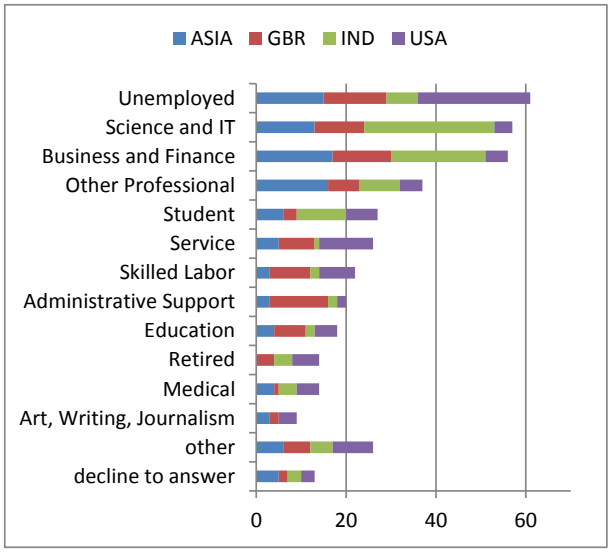

Figure 13. The participants' occupations by country.