Analysis of Configuration Decision Space Over Time: The Google Inactive Manager Account Case

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ABSTRACT

Some configuration settings have immediate impact on system state; others have impact over time. In group systems, the timeline of impacts can be even more complex, because changes may impact not only the user who made them but also other users. When a system is designed, its designers plan what configuration settings to provide users with, as well as how these settings will affect the system and when. They must also help users anticipate how these settings impact the available interactive paths over time, so that users can make informed decisions about their settings. In this paper we show how two analytical tools – the Semiotic Inspection Method (SIM) and the Configurable Interaction Anticipation Challenges (CIAC) – can be combined to probe the complexity of decisions that users may take in during a configuration task. We take Google Inactive Account Manager as our case, since all the decisions involved relate to future effects.

Author Keywords

Configuration, impact over time; collaborative systems, semiotic inspection method, anticipation.

ACM Classification Keywords

H.5.2. User interfaces

INTRODUCTION

Digital technologies are embedded in many aspects of people's daily lives: in their work, entertainment and civic behavior. Through social computing systems people interact with other people, generate and store significant data over time, including work files, personal and professional contacts, photos, etc. A challenge in designing such systems is to represent all of the many nuanced effects that people's interaction with each other may have in the physical world. Ackerman [1] argued that the mismatch between what is required socially and what can be done technically – the social-technical gap – is a fundamental problem for collaborative systems and much of it applies in social computing contexts.

One approach to narrowing the social-technical gap is the creation of flexible systems that allow users to *tailor* a system to their contexts, needs and preferences. Many researchers have explored related ideas, including both customization (allowing users to choose among behaviors already available in the application) and end-user development (allowing users to create, modify or extend their own software artifact) [9,9]. Research has investigated a broad set of issues, such as how users collaborate to tailor a system (groupware or not) [15]; toolkits [8] and frameworks [21] that support the development of adaptive groupware systems; and how to support users in understanding the impact of their choices in groupware [20].

In spite of the broad array of research on adaptation of group and social computing systems, researchers have not considered configuration decisions that have their effects over time. One reason may be that these sorts of time-dependent configurations are only now starting to play a larger role in existing systems. Increasingly, a user makes decisions that change not only the next state of the system, but also the possible *interactive paths* (the set of states achievable by future actions that have been enabled by the current decisions). For instance, concerns about specifying future states in Facebook have emerged, ranging from cleaning up profiles[1] to what happens to profiles when users pass away[2].

Our research focuses on the challenges of specifying configurations in group systems that may impact future interactive paths. When such configuration possibilities are offered to users, designers must support users in anticipating *at the time of their decision* the impacts that they may have on future interactions with other users or on how their information or digital artifacts might be accessed (e.g. data, photos, files, etc). For example, Pereira Jr. et al. [14] illustrate the difficulties that Facebook users have in understanding some of the potential consequences of posting a photo to friends. While they understand that the photo will be visible to their friends, it is not clear what these viewers

[2] https://www.facebook.com/help/103897939701143?sr=3&query=death&sid=1FrBjCPgZTnu83R2H (Last visit: August, 2016).

or other users can do with the photo, or who might be able to gain access to it eventually.

In this paper, our goal is to investigate how we can use two analytical tools to probe the complexity of decisions that users may take in during a configuration task that come into effect over time. The analytical tools selected are the Semiotic Inspection Method (SIM) [6, 7] in combination with the Configurable Interaction Anticipation Challenges (CIAC) [16]. SIM allows for a systematic analysis of the decision space being offered to users through the system, whereas CIAC focuses on the analysis of potential issues related to configuration settings whose impact unfolds over time.

As a case study we have chosen Google Inactive Account Manager (IAM) since it can be seen as an interface for users to express their digital legacy wishes [17]. Google IAM is an especially interesting case because it has been designed to handle decisions about accounts that become inactive because their owners are (likely) no longer available to take action themselves. Thus, they should not be able to verify if the settings they choose in the present achieve the intended impacts in the future (and make changes if they do not).

RELATED WORK

Configuration is a popular solution for adding flexibility to a computational system. With configuration settings, users can adapt aspects of the system (e.g. functionality or look-and-feel) to better fulfill their needs or preferences. To support configuration, system designers decide *at design time* what parts of the system users will be able to configure and which are the set of parameters and values that best represent them.

Group system configuration research covers earlier collaborative systems applications as well as social computing. In collaborative systems, Wulf et al. [21] have addressed flexibility at 3 levels. The *architecture* level focuses on deeper architectural rearrangements; the *interface* level, on supporting changes by end-users; and *collaboration* focuses on providing support for sharing tailored artifacts among groups.

In the present work, we focus on the *interface* level, and more specifically on user configuration over time. Users' configuration can have a range of impacts on systems, especially when considering group systems in which changes can affect both the users themselves and other users. They also can impact both the current *state* and future *interactive paths* of the system [16].

An impact on the system's *state* means an immediate impact on the interface or behavior of the system (e.g. including a button in a toolbar or changing the visibility of a document in a collaborative editing system). Solutions ranging from providing users with awareness [2] to creating specific graphical interfaces used to visualize and interact with a set of parameters [4,18] have been proposed to support users involved in understanding configuration changes.

Impact on *interactive paths* of a system means that the changes have an effect not only on the state, but also on actions (other) users can take as a result of that change. For instance, in Facebook, setting the visibility of a photo to one's friends has an impact on the actions those friends can take (e.g. tag someone in the photo); these actions in turn may change the initial user-specified visibility of the photo. This interactive path is one of many that may (or may not) take place due to the specification; such impacts (if any) may occur now or at any moment in the future.

In this direction some researchers have proposed that users should be able to explore (some) future interactive scenarios using a simulator. Wulf and Golombek [20] allowed users to explore the filtering of settings used to publish or receive information by simulating different setting combinations across two users. Pereira Jr. et al [14] noted problems Facebook users had in understanding the effects of their privacy settings for photos. They proposed a simulation environment that would visualize an abstract relationship network and allow users to ask "what-if" questions about settings, including possible impacts of other users' actions on photo visibility.

Although some of these papers investigate how users can explore future scenarios and interactive paths, they do so for specific case studies. Their results show that allowing users to explore and interact with the future scenarios improves their understanding of them. However, no one has offered general guidelines, criteria or methods that could be used to evaluate the broader problem of how systems support users in understanding the effects of settings over time.

After identifying the digital legacy scenario as an interesting case, we also looked at the research in this specific application arena. We found that such research has mainly contributed to identify needs, requirements or guidelines to develop systems for the bereaved, or supporting people to prepare for their own deaths [11, 12]. We found none addressing the impacts of user-specified configurations over time.

CONFIGURABLE INTERACTION ANTICIPATION CHALLENGES (CIAC)

As designers decide at design time the configuration settings that will impact interactive paths over time, they should consider whether and how users will be able to understand such future possibilities *at the moment they are changing configuration settings*. As a step in this direction, Prates et al. [16] have proposed five challenges – Configurable Interaction Anticipation Challenges (CIAC) – that might help in this planning process:

Anticipation support: there may be a large or even indefinite number of possible interactive paths that may be enabled by a configuration setting. Can users anticipate the effects their decisions may have now or in the future (all of them or the most relevant ones)?

Representation: in defining the configuration, there are two aspects that designers must define: 1) the settings interface; 2) representing the possible effects of setting choices to users. If the settings interface makes use of a common set of interface elements, users will be familiar with them (e.g. choosing which elements of a menu should be displayed in a toolbar). However, the settings interface may also introduce new signs that refer to aspects of the interface that only make sense in a configuration settings dialog (e.g. the name to show in a collaborative editor when a comment is added). Regarding configuration effects, designers must weigh pros and cons of an abstract representation versus a simulation of the actual interface, as well as whether and how future scenario exploration will be supported.

Cost x benefits: analyzing the possible effects of a decision will have a cost to users, so designers should consider in which situations the benefits would be worth the cost. What are the advantages of an informed decision and how does this compare to the cost of not having information about the potential impacts?

Conflict negotiation and mitigation: In group systems, when decisions have effects on others, conflict may arise. Designers should identify possible conflicts and how to support users in mitigating them.

Definition of default values: Configuration settings often require designers to define default values. In this case designers will make decisions about which default values are most appropriate. Do these default values represent users' expected preferences? Do they represent an intended use for the system?

In the next section we present how these challenges were combined with the Semiotic Inspection Method to allow for a systematic analysis of how any interactive system is addressing them.

METHODOLOGY

Our goal was to perform a systematic analysis of Google IAM, using CIAC to analyze the configuration decision space regarding inactive account management offered to users by designers (i.e. the Google design team that defined IAM's functionality and presentation). We use the Semiotic Inspection Method (SIM) to do this because: 1) SIM enables systematic analysis of an interactive system's interface [6,7]; 2) SIM is based on the Semiotic Engineering theory of HCI and analyzes the interface as a communicative act from designers to users focusing on designer's decisions about the system [6, 7]; 3) Previous work has shown that SIM can be applied to different domains and take into consideration different aspects of the interface [19], which allows for the integration of the analysis of CIAC into the method. We next provide a brief explanation of the theoretical foundation necessary to understand SIM, and then we present SIM and how CIAC analysis was incorporated into it.

Semiotic Engineering Theory of HCI in a Nutshell

Semiotic Engineering [5] is an HCI theory that perceives an interactive system as a communicative act from designers to users. Designers communicate decisions regarding who they believe the users are, what problems the system can solve, and how users interact with it to do so. The system acts as the designer's deputy and conveys to users the designer's message, that can be paraphrased as:

"Here is my understanding of who you are, what I've learned you want or need to do, in which preferred ways, and why. This is the system that I have therefore designed for you, and this is the way you can or should use it in order to fulfill a range of purposes that fall within this vision."

The message is transmitted indirectly to users, who grasp it as they interact with the system's interface. Thus, in Semiotic Engineering the interface is perceived as a meta-message because it conveys the designers' message to users by exchanging messages itself with users (user-system interaction).

In this theoretical framing the quality of the interface is associated to the quality of the designers' message to users – that is, its communicability. Communicability is the distinctive quality of interactive computer-based systems that communicate efficiently (in an organized and resourceful way) and effectively (achieving the desired results) to users their underlying design intent and interactive principles [7].

A message being transmitted is comprised of signs. A sign is anything that someone can take to stand for something else in some respect or situation [13]. In Semiotic Engineering interface signs fall into one of three classes: static, dynamic and metalinguistic [6, 7]. Static signs are those whose meaning can be interpreted independently of temporal and causal relations (e.g. menu options or toolbar buttons). Dynamic signs, in contrast, are bound to temporal and causal relations and represent the system's behavior (e.g. when the user clicks on a link or button labeled "Change this setting" a dialog about the setting to be changed follows). Finally, metalinguistic signs refer to other (static, dynamic or metalinguistic) signs (e.g. an explanation on what a configuration parameter refers to).

Currently, there are two main methods for assessing the communicability of a system – the Communicability Evaluation Method (CEM) and the Semiotic Inspection Method (SIM) [6]. In our case study, we use SIM because it focuses on interface meanings and design intent expressed by the designers of the systems. In other words, it focuses on the emission of the meta-communication message.

Semiotic Inspection Method (SIM)

SIM is an inspection method and thus is an interpretive and qualitative method. However, different from the other inspection methods the goal of SIM is to explore the communicative potential of interactions, including the identification of design intent, communication contents, expressive choices, and alternative paths, both successful and unsuccessful. As part of the process the evaluator is required to reconstruct the designer's meta-communication using the message's paraphrase as a template.

To prepare for SIM the designer defines the focus of the analysis and scope of the evaluation, and prepares an inspection scenario [3] that will provide the contextual structure required for the communication analysis. The method is then carried out in five steps: the three first ones are a segmented analysis in which the evaluator examines all the 1) metalinguistic signs, 2) static signs, and the 3) dynamic signs in the system related to the inspection scenario. At the end of each of these steps the evaluator reconstructs the meta-communication message based on the inspected signs of the corresponding step. In step 4 the evaluator contrasts the results and reconstructed message from each of the previous steps. The evaluator should analyze the results from each step, identifying points at which they are consistent or redundant, and pointing out any inconsistencies and gaps that may be identified among them. Finally, in the fifth and last step the evaluator reconstructs a unified meta-communication message and assesses the costs and benefits of communicative characteristics and strategies. Figure 1 illustrates the steps of the method.

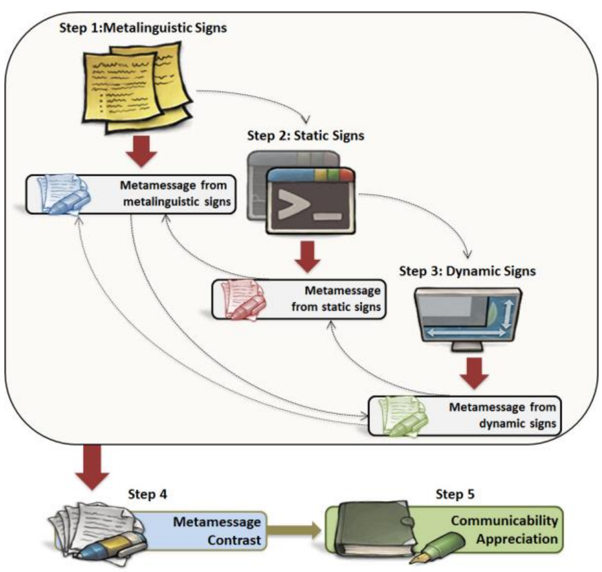

Figure 1. Semiotic inspection method

To combine CIAC with SIM method in steps 1 to 3, the evaluator explicitly registered and analyzed signs for each of the classes that conveyed decisions relating to any of the five challenges. In step 4, besides the required analysis, the evaluator explicitly analyzed signs, communicative aspects and design intent related to each challenge. In other words, no changes were made to the steps of the method, but rather the analysis of the challenges was embedded to provide a specific focus on what was being conveyed to users. For instance, besides reconstructing the meta-message template, the evaluator also considered what designers had conveyed about support for anticipation, such as *Does the system allow users to anticipate the effect considered by the designers? If so, how and in regards to which settings?*

In this case study, an evaluator with expertise in SIM and HCI integrated CIAC and conducted the analysis in March 2015, using this inspection scenario:

Jim is a professor who operates almost entirely in the digital realm. He is very organized with his email, redirecting accounts to Gmail, where he tags and separates files that are work related, that relate to bills or shopping or are personal. He also uses Google systems to save documents, pictures, videos and other types of data. When Paul, a good friend of Jim's passed away unexpectedly, Jim started thinking about what would happen to all his digital "stuff" if he were to die. He found that Google allows users to specify what to do when an account becomes inactive. He wanted to know what decisions about his "stuff" could he make and what would their effects be once his account became inactive.

Note that Google IAM is an intrinsically asynchronous group system, since users' interaction to determine the future of their digital assets will (usually) determine how other users will interact with the system at a later moment. Although the scenario does not explicitly mention the group aspects of the system, they were analyzed in the inspection of the system when considering the effects of users' decisions.

RESULTS

In this section we present our primary results organized into three sections: in the first one we present reconstruction of the designer's meta-message to users, in the second one we summarize the decision space that is offered to users, and on the third discuss the findings according to each CIAC challenge.

Reconstructing Google IAM Designer's Message

In the final step of SIM the evaluator generates a unified meta-communication message based on the contrast of the meta-messages generated in previous steps. Here we present this final meta-message generated according to the SIM template. ("**We**" refers to the Google IAM designers, and "**you**" to users.)

''Here is my understanding of who you are,...''

We understand that you are a Google user who has data stored in Google products.

"... what I've learned you want or need to do, ..."

You want to plan for the future of your digital assets stored in Google products. You want to determine who should be notified and who should have access to which of your data, when your account becomes inactive, that is, when you stop using it for any reason.

"... in which preferred ways, and why."

You want to be the one to decide if you want to do this planning and if so, when you want to do it. Also, you want this to be easy and quick to do.

"This is the system that I have therefore designed for you and this is the way you can or should use it in order to fulfill a range of purposes that fall within this vision."

I understand that you are the best person to tell us how long without any activity we should wait before considering your account inactive (consider a period between 3 and 18 months). Also, we want to make sure that it really is inactive and will send you an alert, so that you have the chance to prevent it from being considered inactive if that is not actually the case. To do that, you must provide us with a cell phone number and we will send you a verification code to confirm the number. We will also send a message to your Gmail account and any other email accounts you wish.

Also we believe you would like trusted contacts (up to 10 people) to be made aware that your account is now inactive. You can either just notify them or also give them access to any of your data available in some Google products. For each trusted contact we believe you will want to write an individual message. For those you wish to grant access to download (part of) your data, you must also provide a cell phone number. The phone number will be a way for us to guarantee the security of your data, because once the trusted contact is notified he or she will be sent a verification code using the cell number to guarantee that only the intended person will be able to download your data. Your trusted contacts will not be informed of their nomination until your account becomes inactive. They will then receive the message you wrote to them with an explanation from us saying that we have been instructed by you to send this message, and for those to whom you grant access to your data, we will also include the instructions on how to download the data. You can also write a message to be sent automatically as a response to anyone or just to your contacts who email you.

You can also decide whether you would like us to delete your account and data after it has become inactive or not. In case you do, it will only be deleted after your instructions regarding notifications and access have been carried out.

Because our goal is to offer you a simple and easy process, we explain each of the steps to you in a "just in time" fashion. The first time you enter the settings we provide an explanation of what it is meant for and what steps are involved. The next times you enter, this is not needed, but it will be available on demand. For each step, we provide brief instructions that will allow you to change the settings easily.

The User´s Configuration Decision Space

The reconstruction of the designer's meta-message identifies and describes the decision space that Google IAM designers provide to users in regards to planning the future for their digital assets. The decision space involves the definition of four settings: *Alert me*, *Timeout period*, *Nominating trusted c*ontacts and *Deciding on deleting or not the account*. The timeout period settings determine when the settings will come into effect, and the "alert me" warns the user before they do, guaranteeing that it is the users' intention and that they are not taken by surprise.

Nominating trusted contacts and deleting the account will impact not only the user him/herself, but also other people – those appointed as trusted contacts; those who get an automatic Gmail response; or those who try to interact with available assets in the future (e.g. an inactive user's YouTube channel).

CIAC Guided Analysis

As explained in the methodology section, we used CIAC as a guide in step 4 of the SIM analysis, to inspect if and how designers had dealt with each of the challenges related to configurations with future impact. We next present the analysis for each of the challenges.

Anticipation support. For Google IAM there are two decisions that have primary impact on interactive paths: nominating trusted contacts and deciding about account deletion. Therefore, our analysis of anticipation support focused on identifying if and what kind of signs the Google IAM designers communicate to users for anticipating the effects of these decisions.

Users are told in natural language by Google what will be the effects on a nominated trusted contact once their accounts become inactive. There are two impacts on trusted contact: (i) they will get a message from the account owner written at the time of the configuration setting; (ii) they will gain access to (some of) the data (only those with whom users decide to share their data). About the message (i), Google IAM tells users as part of the dialog in which they write the message that the email will be sent once the account becomes inactive (Figure 2(b)). The "About Inactive Account Manager" help page reinforces that the trusted contact will not receive any notification at setup time, and shows an example of the footer Google will add to the message (Figure 2(c)). However, there are no links from the configuration setting to this help page.

About gaining access to data, when selecting the data to be shared with the trusted contact the user is informed that the trusted contact will have 3 months to download it (Figure 2(a)), and that they will need the verification code to be sent to the cell phone registered by the user to access it. In the next dialog, in which users write the message, the user is told that additional information on how to download the data will be included in notification message (Figure 2(b)). As mentioned, an example of what it might look like is shown at the "About Inactive Account Manager" page (Figure 2(c)). However, the example message to be sent to trusted contact does not mention the verification code, the deadline for downloading the data.

Finally, regarding the impact of deleting their account, at the configuration setting interface Google IAM explains that all data associated with their account will be deleted, including publicly shared information. The help page notes that distinct Google products will be affected differently. It does not offer any explanation about how each one will be affected, nor where users may find that information. However, it does point out that if the Gmail account is deleted, users will no longer have access to their email and nor will they be able to reuse their Gmail username. The settings dialog informs users that the account will only be deleted once the user's requested actions have been completed.

Representation. The Google IAM configuration dialog does introduce new signs that are not present in the interface of Google applications. Although the interface widgets used to represent them are known to users (i.e. buttons, links, labels, etc.), new concepts are introduced, such as "timeout period" and "trusted contacts". In these cases, as described in the meta-communication reconstruction, the meanings of these signs are explained to users at the point at which they will need to make a decision about it.

Most of the support offered to users to represent the anticipation effects of their settings is through explanations in natural language. The only exception is the footnote to be added to the user's message, for which an example of what it **might** look like is shown. The fact the designers used the word "might" may indicate that they are aware that an unknown period of time will pass between defining the settings and their effects taking place, and that the message could change during that period. It could also be because they may have chosen not to detail the whole message, but parts of it. As mentioned, no explanation about the verification code or how long the user has to take action is included in the example message.

One may argue that the use of explanation and an example depicted as a static sign are reasonable or good choices because the number of decisions and effects to be presented is small. However, the fact that the explanation is spread across different pages (as shown in Figure 2), with little (or no) redundancy among them might make it difficult for users to gain a full understanding of these effects.

Cost x benefits. In analyzing the cost of the Google IAM settings there are two stakeholders to consider: users and trusted contacts. On the user's side there is the cost of changing the settings and anticipating its effects. On the trusted contact side the cost is taking the action(s) requested by the user, for example verifying one's identity and downloading the data that was shared. The user only needs to make four decisions and take six steps to specify the future of his or her digital assets (i.e. change the settings). These settings can be also easily changed after being defined, and enabling or disabling IAM (once the settings have been defined) only requires one button press. The cost of understanding all the effects to their account and digital assets is a little more costly because it requires users to also visit the help pages about IAM, as well as making sense of information that is presented at different moments in different interfaces.

Users may also wish to anticipate the effects for the trusted contacts they have nominated. Although there is an example of the message with instructions that they might receive, the costs associated with downloading (time or storage space) are not mentioned. In the help page users are informed that they may see the data associated to their account in Google Dashboard. If users go to Google Dashboard there is information about each product (e.g. number of contacts; number of conversations in Gmail), but not about how much storage space the information takes.

Moreover, users may be interested in anticipating if they would be able to recover from any unintended effect and how, especially if their account became inactive and they want to reactivate it. Google IAM tells them that they will take precautions to prevent that through the "Alert Me". However, this situation is not explicitly considered in the interface or help. The only implicit references are: 1) if the account is deleted, there is no way to recover their username in Gmail; and 2) in the help page aimed at trusted contacts, one of the reasons listed for the contact not being able to download the data, is that the user signed back in and reset the countdown for the timeout period. Because the trusted contact only gets the instructions about downloading after the account is deemed inactive, it seems that even after it is "inactive" the user may log back in and reactivate it, unless the user has chosen to delete it, and that action has already been carried out.

For the trusted contact there is no cost at the time in which the setting is being defined, because they are not informed of their nomination as a trusted contact. Any such cost would arise at the moment when the account becomes inactive and they are notified by Google of their status, and are required (if it is the case) to take actions to download the users' data. In this case, the main costs would be the storage space that may be required, but also recovering from any breakdowns that may take place in the process of downloading the action. The help page aimed at trusted contacts only explains what could cause the trusted contact not to be able to download the data, but not how to recover from the situations, which may imply that there is no possible recovery.

Finally, the emotional cost involved to users and trusted contacts should also be considered, given that account inactivity may be triggered by unhappy events such as an incapacitating health problem or even death. When users are making plans for their digital assets, they may consider these scenarios and especially when writing the message to each trusted contact (which is not optional). For the trusted contact, on their turn, there may be an emotional cost associated to being informed that they have been nominated a trusted contact and are now expected to be responsible at some level for the user's digital assets future, especially if they are caught by surprise. Also there may be a cost associated to getting the message from the user, especially if some unfortunate fate has stricken the user. Finally, there might be an even higher cost if after receiving a notification they find out that due to some problem (e.g. a new cell number) they are not able to take the requested action.

Conflict negotiation and mitigation. In a configuration context such as Google IAM, potential conflicts could arise between user and his/her trusted contacts regarding trusted contact nomination, or among trusted contacts regarding a user's digital assets. Google IAM designers have left all potential conflicts out of the realm of Google. The decision not to give users the option to notify trusted contacts at the time they are nominated suppresses any conflict related to a contact's unwillingness to serve in this role. Trusted contacts are only notified once the account becomes inactive, and at that moment the user may no longer be available to negotiate, or at the least any such negotiation will take place outside of the system.

In the case that users are no longer available when their accounts become inactive, different trusted contacts might have differing views on what should be done with the assets. The designers also avoided this conflict by: (1) limiting trusted contacts to download (a copy of) the data; (2) by not telling trusted contacts if there are others, who they are or what access they have.

Users can grant access to their data, but it is up to them to decide if they want their data deleted or not; they cannot name a trusted contact to make decisions for them. It could make sense for a user to name a trusted contact to make that decision, but then different views from trusted contacts could arise in a dispute about the course of action to be taken. All trusted contacts granted access to data will have their own copy, so no conflicts regarding who is (or should be) responsible for which data will arise among them. If any conflicts should arise from the use trusted contacts choose to do with the data (e.g. make it available publicly) it will take place outside Google's responsibility.

Definition of default values. In the case of Google IAM there are not many decisions for which a default value is provided. First of all, setting Google IAM is an option, and by default it is disabled. Within the Google IAM design space the only defaults are: email for notification which is set as the user's Gmail (this cannot be deleted, but others may be added), the timeout period that is set as the minimum (3 months) and the option to delete the account that is set to "No".

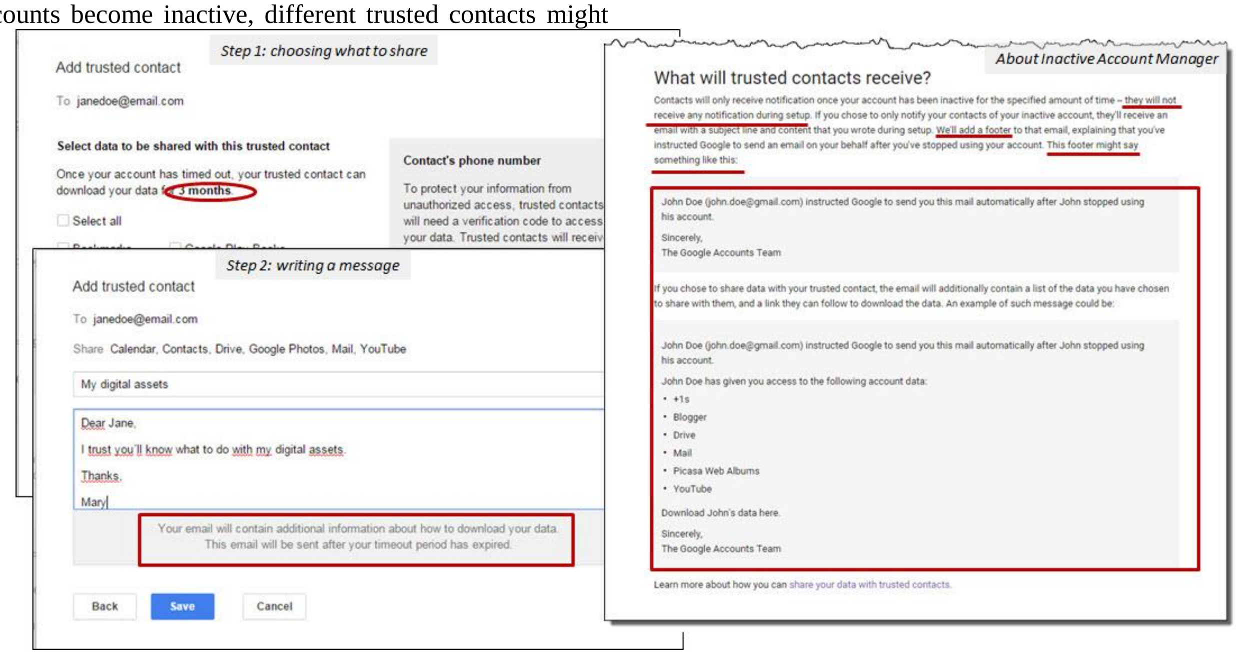

Figure 2. Information effects scattered in (a) sharing dialog (b) writing a message dialog; (c) help page

The default values set are not enough for users to enable their IAM, at least their cell phone must be provided and verification code entered. If users just enter this information and accept all the defaults there will not be a high cost to them, because it would mean that they would be notified before their account becomes inactive (i.e. if they do not interact with it for 3 months), but no one else will be notified, and the account will not be deleted. Also, if it becomes inactive, the implicit communication in the help pages implies that reactivating it would have a low cost – just log into their account.

DISCUSSION

Google IAM configuration settings are aimed at supporting users' planning for the future of their assets. However, part of this planning involves establishing an asynchronous communication between users and their trusted contacts. One of the plausible scenarios that could lead to the account becoming inactive is the death of the user. In this situation, not only is the communication asynchronous, but also unidirectional, because the trusted contact will not have the chance to continue the communication with the user.

Google does not mention anywhere in the interface the words "death" or "digital legacy". Nonetheless, in Google's Public Policy Blog, Google's product manager announced the IAM as a means to "*plan your digital afterlife*"[3]. Google IAM seems to take the role of a lawyer who executes the user's wishes according to the "law" (Google's terms and conditions, IAM rules), once the user is no longer available.

For some of their decisions, Google IAM designers explicitly explain the rationale behind their decision (e.g. why they request a cell number for trusted contacts). However, they do not provide any reasons for not allowing users to choose (or not) to notify trusted contacts (at setting time); why users cannot empower trusted contacts to make (any) decisions on their behalf; or why trusted contacts are not made aware of other trusted contacts. Once again the designers might be reinforcing the role of Google IAM as the mediator in defining the future of digital assets. It is also plausible that the goal to avoid any possibilities of conflict within the realm of Google's action played a role in these decisions. After all, one can easily imagine that some situations, especially ones concerning digital legacy, could end up in conflict and even involve legal repercussions in the physical world. For instance, suppose trusted contacts had to make a joint decision whether or not to delete the user's account or that one of them was responsible for making this decision and the others did not agree with it. Google is unlikely to want to be part of that conflict.

In the context of IAM, all configuration effects will take place in the future, so supporting users' anticipation of such effects is essential. As we have described, Google IAM provides such support through natural language and one partial example, depicting the footer but not the whole message that will appear in a notification (see Figure 2 (c)). Even if this solution is appropriate, Google IAM makes it harder by not presenting all the information in a single location.

Furthermore, Google IAM does not support a process for users to explore the future effects of their configurations. There are a number of possible scenarios that are not (clearly) referenced to in the existing explanations. For instance, there is some indication that the user might be able to easily reactivate an inactive account that has not been deleted, but this scenario is not explicitly presented, and the bits of information that could lead to this conclusion are scattered through different pages. Other questions such as "Why is there a time limit for trusted contacts to download data, if the user has chosen not to delete it?"; "If trusted contacts do not download it in this period, would they be able to get a second chance to do it?"; "When users choose to delete account and have data shared publicly (e.g. YouTube), will people be informed of it and how?"

It would also be interesting to support users' exploration when planning the future of their digital assets. In Google IAM users can name up to 10 trusted contacts, and may select which Google product's data they want to share with each of the trusted contacts. Although users may be able to keep track of which data has been shared with whom, or whether the data of a specific product has been shared with any of the contacts, it may be costly to do so.

Previous literature has shown that allowing users to visualize the future states resulting from their decisions and exploring them (e.g., in a simulated environment) would improve their understanding of the decisions [14, 20]. Building such supports would increase the cost of providing users with services like IAM. Nonetheless, if the design space for user decisions increase (for instance, allowing users to make decisions of data stored in other Google products[4], or defining access to data not by the product it is associated to, but rather by use of finer criteria, such as the tags used to organize it) these

[3] http://googlepublicpolicy.blogspot.com/2013/04/plan-your-digital-afterlife-with.html (Last visit: August, 2016).

[4] Currently (June, 2016) Google IAM does not seem to include all of Google products (http://www.google.com/intl/en/about/products/)

tools may not only be desirable, but necessary for decision-making.

Finally, one of the plausible and even expected scenarios of use for Google IAM is as a digital legacy planner. If this is the case, its use may evoke deep emotions for both users and trusted contacts. Users must think about their own deaths and wishes and which messages they would like their trusted contact to receive when they are gone. Later (up to 18 months), the trusted contact (or in this case the bereaved) will receive instructions written by someone they cared about. IAM minimizes dealing with any emotional aspects by omitting references to death and framing it in a broader context. Even within this approach, simple strategies such as allowing users to preview a message to a specific trusted contact could help them gain a better idea of how to frame their request.

CONCLUSION

In this paper we investigated how SIM combined with the five Configurable Interaction Anticipation Challenges could be used to analyze the configuration decision space of a collaborative system. By combining the two, we have operationalized a systematic analysis of how designers deal with each one of the challenges in a configurable system.

The application of SIM and CIAC allowed us to perform a deep and thorough analysis of the design space Google IAM designers provide to users regarding their planning for the future of their digital assets, as well as to raise and discuss issues regarding anticipation of the future effects may have on users and trusted contacts and the problems in the chosen representation and possible solutions to them. Also, although the cost of the changing configuration settings is low, other costs associated to having a thorough understanding of their impact are higher. We discuss how Google IAM designers have avoided any potential conflicts among users or trusted contacts within the realm of the system.

The results indicate how a communicability analysis using CIAC can be useful in evaluating configurable collaborative systems that have impacts over time. Although we have not compared our analysis with comparable results of the applications of other evaluation methods, we can speculate that methods that focus on users' performance would likely miss most of the issues raised, because these issues would not be likely to affect users' success in completing the settings dialog (which as we have noted is quite simple).

Google IAM was chosen for the case study because its configuration decisions will clearly have an impact in the future. In terms of collaboration, we can say that it enables only a "limited" collaboration, because the connections are asynchronous and have a reasonable chance of being unidirectional. This probably indicates that it would be even more relevant to do a focused analysis using CIAC for systems that provide for a more intense collaboration, because such systems might have larger impacts on interactive paths; the need for anticipation support would be greater; and the process would probably require representations that go beyond natural explanations and a few examples.

Finally, the results obtained through the analysis of Google IAM indicate that using the challenges could also be useful during the design of collaborative systems with configuration settings whose impact take place over time, since it could lead designers to reflect about the challenges and on how to address them.

The next steps in our research involve evaluating Google IAM with users to collect their views on the interaction anticipation issues of the system. The evaluation will involve guiding the interaction in combination with interviews aimed at assessing the CIAC challenges. Given the indicators obtained in this work, we also intend to apply SIM + CIAC to other case studies, so we can explore different configuration decision spaces and resulting interactive paths.

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