

Adaptive Software-based Feedback Acquisition: A Persona-based Design

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Abstract— Users’ feedback is vital to improve software quality and it provides developers with a rich knowledge on how software meets users’ requirements in practice. Feedback informs how software should adapt, or be adapted, at runtime and what evolutionary actions to take in the next release. However, studies have noted that accommodating the different preferences of users on how feedback should be requested is a complex task and requires a careful engineering process. This calls for an adaptive feedback acquisition mechanisms to cater for such variability. In this paper, we tackle this problem by employing the concept of Persona to aid software engineers understand the various users’ behaviours and improve their ability to design feedback acquisition techniques more efficiently. We create a set of personas based on a mixture of qualitative and quantitative studies and propose PAFA, a Persona-based method for Adaptive Feedback Acquisition.

Keywords— *User Feedback; Requirement engineering; Persona*

I. INTRODUCTION

Users’ feedback is a main source of knowledge to guide software autonomous and semi-autonomous adaptation, maintenance, and evolution decisions. The reliance on users’ feedback and their collective judgement to shape such decisions is called Social Sensing [38] and Social Adaptation [1]. In practice, software developers/companies are interested in users’ feedback for two main reasons. The first relates to classical business and marketing purposes. This views users as clients and developers/companies should be always responsive to their feedback and emerging needs. Also, users can sometimes harm the online reputation of the software and, thus, the company if they leave constantly negative feedback. Consequently, software developers/companies keep seeking users’ feedback to assess the acceptance of their software. The second reason relates to the need for a real-time feedback from users’ about the environments, features being used, errors occur and in which context. This feedback is meant for a more detailed view on the use of software and help directly in its adaptation and evolution [38, 3].

In software systems users can be involved in different ways. They can be actively working on a specific software engineering activity. For example, in development styles such as users-centred design, users can suggest modifications and enhancements and perform tests at the development stage.

Alternatively, users can influence the engineering decision about software without being directly part of the engineering process. For example, users might provide feedback, rate specific decision, or influence the opinion of others whether to use certain software [2]. From a Requirement Engineering perspective, users’ involvement via their feedback while they are using the software in practice is more credible to assess how the software is playing its role in meeting their requirements in practice [1, 38, 3]. In fact, many of the users’ requirements are only identified after the software is being deployed and once users get the chance to use it in a real context [4]. This becomes even more evident when we consider the requirements which emerge because of the existence of competitive technology and peer pressure.

Since giving feedback is generally a voluntary activity, the design of feedback acquisition should focus on the volunteers; the users. However, our recent studies in [5, 6, 7] showed that users’ perception and behaviour with regard to feedback acquisition significantly vary and are affected by a number of factors such as interface design, volume and frequency of feedback requests, the language used, etc. This highlights the need for an adaptive feedback acquisition that can cater for such diversity to make users more motivated to respond to feedback requests. This will also have a positive side-effect on the feedback quality, users’ engagement with the software, users’ satisfaction and trust in the system [5, 6]. Poorly-designed feedback acquisition can harm the collected feedback quality, users’ experience and software’s success [3, 5].

In this paper, we present a possible solution to the challenge of integrating users’ different behaviours and perceptions in the design of an adaptive feedback acquisition by employing the concept of Persona [8]. Personas are meant to increase software engineers’ understanding of various users’ behaviours and improve their ability to design feedback acquisition more efficiently. We develop a set of behavioural personas based on a mixed methods approach (sequential-exploratory approach) and propose a persona-based method for the design of adaptive feedback requests.

The paper is structured as follows. In Section 2 we give an overview of personas, feedback acquisition, and our approach to develop personas. In Section 3 we present and discuss our developed personas. In Section 4 we discuss the impact of personas on the design of feedback acquisition and introduce a number of candidate approaches to utilize personas in designing feedback requests. In Section 5, we propose our PAFA method, a persona-based method for the design of adaptive feedback acquisition process. In Section 6 we discuss

our findings further and the threats of validity and in Section 7 we draw our conclusions and recommendations for future research in this area.

II. PERSONA AND FEEDBACK ACQUISITION

Given the high diversity in users' behaviour and perception to feedback acquisition, which we demonstrated in [5, 6, 7], the challenge is how to represent this diversity in an actionable and meaningful way that can inform the design of an adaptive feedback acquisition. To tackle this challenge, the Persona concept is adopted. Persona, as a concept, has its root in marketing then Cooper [8] proposed the use of Persona as an interactive design tool to model user experience in software development [9, 10].

Cooper [8] advocates the need to redirect the focus of the development process towards end users and their requirements and proposes personas as fictional characters that represent different types of users and their behaviours based on data gathered from ethnographic and empirical analysis of actual users. In [11], personas are defined as "a descriptive model of the user, encompassing information such as user characteristics, goals and needs"

Overall, personas as a user experience design tool gained popularity in both academic and practitioners' communities in the field of software development. Personas as fictional characters are given names, age, gender, photos, occupations, etc. This could reflect important characteristics of the persona or, sometimes, just to bring life to them and make them more engaging at the design phase. Personas have shown to be a powerful tool to represent the aspects of discovered user categories and draw discussions about these categories which can help in the design process of software systems in general [12] and the adaptive feedback acquisition in particular.

A. Benefits of Personas

Personas are not just a design tool but it is also meant to enhance engagement, communication and reality at the design phase of software systems [9]. As discussed in [13, 14, 15], the main benefits of personas as user experience design tool are as follows:

- Personas make the design process easier in which engineers relate to human face and name instead of abstract user/customer data.
- Personas supply a shared, fast and effective form of communication among software engineers and designers.
- Personas describe user needs and wants which limit stakeholders' ability to shape users to their convenience.
- Personas minimize self-referential designs in which designers unconsciously predict their own mental models. This helps individuals realizing how the users/customers are different from themselves.
- Personas also help engineers keep the focus on the limited subset of users (persona) at a time which can result in more robust design decisions.
- Personas are useful for software/product validation purposes in which proposed designs, features and

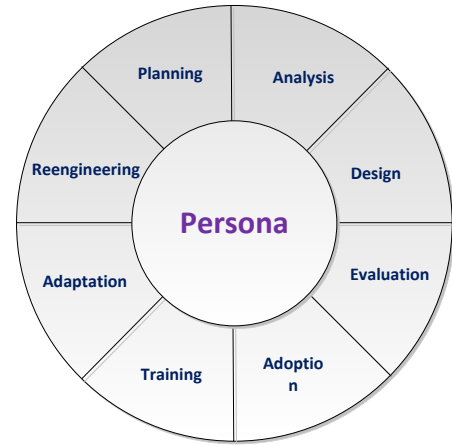


Fig. 1. The role of Personas in the design phase. Adapted from [17]

solutions can be reviewed and evaluated against the needs described by an individual persona.

- The information personas contain can be an inspiration source for the design team throughout the design phase (see Fig. 1) [16].

In the light of the previously mentioned benefits, we adopt personas as a design tool to direct the design process of an adaptive feedback acquisition. It allows software engineers to better understand the diversity of users' behaviours and their needs with respect to feedback acquisition in socially adaptive software towards an effective, fast and shared way of communication. This understanding will positively impact the design of the adaptive acquisition of users' feedback. In addition, Personas are good starting point to initiate detailed discussion about the different types of users (personas) which could highlight new design opportunities for the feedback acquisition activity as we are going to explain in Section 6.

B. Personas Creation

Creation of Personas is still a challenging task and there is not one right way or method to create personas [18]. Ultimately, what the researcher needs to do is to aggregate the qualitative or quantitative data they got about the users into an actionable and meaningful story that can impact the design of a certain product [19]. Personas are affected by several factors that play a role on how they should be created. Generally, it depends on the following factors [18]:

- The targeted audience for the personas and their needs in order to agree to use personas, i.e. the type of information the persona should deliver to software engineers.
- How the personas will be used and for what types of decisions, i.e. is the persona only for initiating discussion or driving the design of a certain product/software?
- The time, money and resources available for the researcher to invest in the creation of Personas.
- The type of research undertaken, i.e. qualitative research, qualitative and quantitative (mixed method) research or quantitative research.

The approach to the creation of personas largely depends on the type of research conducted. Since our previously

published users' studies with regard to feedback acquisition followed a mixed method approach [6, 7], we followed the guidelines for personas creation proposed in [18] and designed our personas according to steps shown in Fig. 2. In our previous research, in [6, 7], we conducted an empirical study to understand users' different perspectives and behavioural aspects to feedback acquisition in software applications. A mixed method (sequential-exploratory approach), consisting of qualitative (interviews) and quantitative (questionnaires) approaches, was followed. Since Mulder and Yaar [18] guidelines are generic, we adapt and specify the approach to the context of feedback acquisition through the following steps:

1. Conducting a qualitative research

The qualitative phase is useful to reveal insights and initial understanding into user behaviours and attitudes. The qualitative phase allowed us to explore and gain insights of users' behaviour in relation to providing feedback in software applications [6, 7].

2. Form hypotheses, foundations and ideas for further investigation

The qualitative phase is useful to help the researcher producing initial and relevant hypotheses, foundations or ideas about users' behaviours and attitude in relation to a certain software/product. These ideas can be then further investigated quantitatively on a larger group of users. The qualitative phase was helpful to figure out the relevant factors of users' behaviours to feedback acquisition. This has been done in [6] and [7].

3. Investigate the formed hypotheses, foundations and ideas quantitatively

The hypotheses, foundations and ideas resulted from the previous steps (qualitative phase) are used to help designing a follow up quantitative approach. In this step the quantitative approach is used to assess the interpretation of the qualitative findings and maximize results generalizability. This also impacts personas validity and credibility since they are based on actual data of a larger group of users. This has been done in the quantitative phase of the study conducted in [6].

4. Segment users based on statistical cluster analysis

In this step, statistical algorithms take an active role in guiding the personas creation in which similar users with regard to their behaviours and attitude are grouped together into clusters. To simplify, the researcher feed a set of variables into statistical analysis software, and it looks for naturally occurring clusters based on some set of commonalities. It tries many different ways of segmenting users through an iterative process. In [6] we used cluster analysis to discover natural groupings in the data and to group similar users together with regard to their behaviours and attitudes to feedback acquisition.

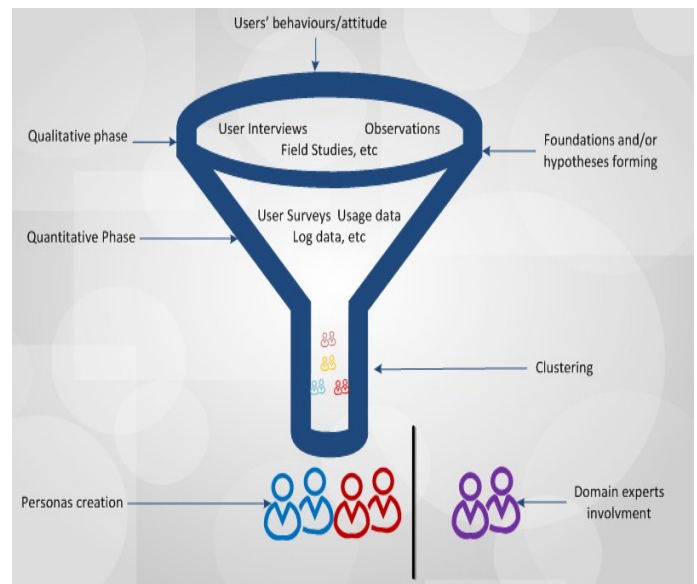


Fig. 2. A visual view of our persona creation approach.

5. Create a persona for each segment (in collaboration with domain experts)

The final step towards the creation of persona is taking the clusters resulted and making them real. This can be done by adding names, photos, and stories to each cluster to transform them into real people. In this stage, we developed four initial personas which can be found at: <http://goo.gl/jLWgPK>.

6. Domain Experts Involvement

Generally speaking, domain experts' involvement can have a high effect on the study's outcome and the acceptability of its results in the wider community [20]. Domain experts' involvement in the persona creation process highly impacts the validity and quality of the created personas. In this phase 11 experts (see Table 1) from industry and academia were involved to evaluate and validate the resulted personas and assess the effectiveness and efficiency of using them to inform the design of feedback acquisition and how they can be used. The selection of experts was as follows:

- Industrial experts: six experts from four highly successful companies in the domain of feedback acquisition were interviewed. Two are small-medium enterprises (SMEs) and the other two are large scale international companies. The work of the two SMEs is primarily on customers' feedback acquisition, analysis and reports generation and they have a noticeable record of success stories with some of the world's largest brands. The industrial point of view is vital to assess representativeness and validity of the users' behaviour each persona represents and encapsulates due to their profound experience with users' behaviour and groups to feedback acquisition. It is also important to assess the effectiveness and efficiency of using personas to inform the design of feedback acquisition and how they can be adopted.

TABLE 1 EXPERTS CHARACTERISTICS.

Experts	Sector	Years of experience	Expertise/Role
Expert 1	Industry (Small-medium Enterprise)	16	Managing director and co-founder
Expert 2	Industry (Small-medium Enterprise)	3	Client service director
Expert 3	Industry (Large Enterprise)	15	Principle Engineer and user UE expert
Expert 4	Industry (Large Enterprise)	15	Researcher and user-centred design expert
Expert 5	Industry (Small-medium Enterprise)	9	Product support manager
Expert 6	Industry (Small-medium Enterprise)	4	Sales manager
Expert 7	Academia	6	User-centred design expert
Expert 8	Academia	7	HCI expert
Expert 9	Academia	11	Persona expert
Expert 10	Academia	9	HCI expert
Expert 11	Academia	4	User-centred design expert

- Academia experts: five experts from academia who are highly experienced and knowledgeable in user-centric design and persona (evidenced by quality publications and track record) were interviewed. The academia point of view was valuable to assess the design and representation of the personas (i.e. style and format). It was also important to assess the semantic and understandability of the personas.

C. Expert interview design

A Semi-structured interview protocol was developed to discuss and assess the validity, representativeness, adoption and design of the initially four created personas. The personas were introduced to the experts prior to the interviews to allow them to familiarize themselves with the personas and provide a better reflection on them. The interview script can be found at: <http://goo.gl/jLWgPK>. Seven interviews were conducted face to face whereas the rest were conducted online using Skype due to accessibility difficulties to some experts. Each interview lasted for about 1 hour and at the beginning of each interview session, each expert signed a consent form. Experts were invited by an email containing a brief description of the purpose of the interview and asking them to participate in it. Experts were also informed about how their input to the study will be used. The data collection took place between January 7 and February 4, 2015. The response rate was high (11 out of 15) which is an indicator that the field is relevant and timely especially to users' feedback, personas and Requirements Engineering which are primary research areas of our experts.

D. Persona representation

Generally a persona represents users'/people's behaviour patterns, goals, skills, attitudes towards certain product/software plus a few fictional personal/demographic details to make it a realistic character. However, in computing fields, such as HCI, there is a lack of detailed studies consensus on what information should be contained in a persona, how this information should be represented and used to impact the design process of software [11]. Goodwin [21] suggested that when creating a persona a researcher should focus first on the critical information for the design such as: the workflow and behaviour patterns, goals and attitudes of the persona, then adding the personal/demographic information (can be fictional and based on designers' own assumptions [22, 23]), such as what the persona does after work (i.e. he goes home to watch movies with his dog).

Courage and Baxter [24] suggested a more concrete/detailed approach for representing personas than Cooper's one [8]. They introduced a set of a persona's components combined with a textual formatted guide to the construction of personas. These components are: Photograph, Identity, Status, Goals, Knowledge and Experience, Tasks, Relationships, Psychological profile and Needs, Attitude and Motivation, Expectations, Disabilities [24]. These components are text-based and act as a generic guide for building and representing personas. We refine these components to fit the context of this work in relation to users' behaviours to feedback acquisition and the information availability of our previously conducted studies in [6] and [7] as in Table 2.

TABLE 2 PERSONA COMPONENTS USED WITHIN THIS WORK (ADAPTED FROM [24]).

components	Description
Identity	includes a short statement/status describing the overall persona's attitude to feedback acquisition (i.e. anti-user of the application)
Profile (fictional)	Includes the first name and a picture of the persona. It also includes a description of basic demographic information such as age group, gender, profession, etc. <i>Note: in this work, fictional information is only meant to bring life to the persona and make it memorable and should not impact the design of the feedback acquisition.</i>
Goals	Indicates persona's goals of responding to feedback requests in software applications.
Behaviour	Describes persona's behaviour and attitude to feedback acquisition.
Culture Suitability	Indicates the persona's suitability to a certain culture. <i>Note: culture suitability doesn't restrict a persona to a certain culture. It just gives a slight and initial indication of its potential suitability to that culture. We mainly studied the difference between western and middle eastern only.</i>

III. DEVELOPED PERSONAS

By enriching the results of our previously conducted studies on users' behaviour to feedback acquisition with the experts' answers, we were able to assess, validate and refine the initially created four personas. This process resulted in a total of 7 personas that encapsulate diverse behaviours of users to feedback acquisition. Some personas are also enriched with information about the cultural impact on users' behaviours to feedback acquisition [7].

Each persona encapsulates the knowledge of potential users in relation to feedback acquisition in software applications which was gathered from the conducted user studies in [6, 7]. The created personas are meant to help software engineers to understand and perhaps predict the behaviour of the users in order to guide the design of an adaptive feedback acquisition towards better functionalities, feedback quality and users' satisfaction. The created personas are summarized in Table3. In addition, in Fig. 3, 4, 5, 6, 7, 8 and 9 a complete view of the developed personas is introduced.

TABLE 3 SUMMARY OF THE DEVELOPED PERSONAS FOR THE DESIGN OF AN ADAPTIVE FEEDBACK ACQUISITION.

Persona's name	Profile	Statement
Linda	Privacy tolerant and socially ostentatious	"Giving feedback is a social and community experience and it helps to feel among others"
Jack	Privacy fanatic and generous	"I think emails are good if you want someone to actually sit down and write a couple of sentences about how they feel about your service popups and other 'push' mechanisms intrude & interrupt flow."
Mark	Passive and stingy	"I find it problematic, hindering and unprofessional to send me any kind of feedback requests. If I'm not happy with something I will go to their website and complain to them"
Sara	Incentive seeker	"What's for me in it? In fact, I wonder why people would give feedback for free."
Hana	Perfectionist/complainer	"I'm perfectionist and I always seek perfection, If I tiny thing is wrong then of course I will speak"
Richard	Loyal and passionate	"If I'm passionate about something, can't stand negative reviews about it. I would always defend it. As simple as that"
Amy	Impact seeker	"The benefits of my feedback are always not clear to me as a user"

Linda



Profile: Privacy tolerant and socially ostentatious
Age: 20
Gender: Female
Job: Undergraduate student
Socially affected to give feedback: Yes
Culture Suitability: Middle Eastern-like
Statement: "Giving feedback is a social and community experience and it helps to feel among others".
Goals: Impact the software with her feedback + raising others awareness about the used software + being socially recognised.

Behaviour to feedback:

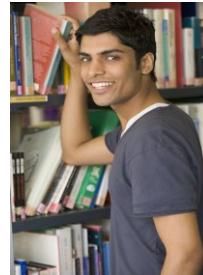
Linda is an undergraduate university student and spends a great deal of time on her computer studying as well as heavily social networking (i.e. Facebooking). **[Discouragement]** In general, she is not a big fan of the idea of dull and typical feedback requests and reminders coming from software applications. **[Motivation]** However, she gets interested in replying to feedback requests when the feedback requests socially motivate her to do so (i.e. by making her socially recognized for her helpful feedback). This is perhaps due to her likeness of social networking and the time she spends socialising with others/friends on the internet which made her motivated towards socially enriched feedback requests. Generally, Linda is positively affected by one or more of the following social factors to give feedback:

- **Volume of already given feedback:** She gets enthusiastic to give feedback when there is low number of feedbacks already given on a software. She believes it's helpful to increase the number of given feedback which will then result in other users having a better and richer idea about the software.
- **Visibility and similarity of other users' feedback:** Linda also gets more interested to give feedback if she is able to see other users' feedback on the software first and then having the option to accept/reject to give feedback.
- **Social recognition:** Since Linda appreciates social networking and gives it a great deal of her time, she likes to be socially recognized for her given feedback which she believes could help others and make her socially popular.
- **Feedback acquisition as a social activity:** This social factor also makes Linda motivated to give feedback as well as engaging with software. For example, she gets enthusiastic to feedback requests when she is able to visualize how her social friends are rating a certain software and how their feedback influenced the trend in her community.

[Method] In addition, Linda prefers to be approached for feedback by using hints and tips to gather her feedback (e.g. by telling her that she can go to a feedback centre for this purpose and leave her feedback) or by using an online method as a second option (i.e. popups while she is using the software). **[Privacy]** Interestingly, Linda does not mind to be implicitly reached for feedback (e.g. implicitly collecting information about her software usage)

Fig 3. Linda: Privacy tolerant and socially ostentatious.

Jack



Profile: Privacy fanatic and generous
Age: 35
Gender: Male
Job: Researcher
Socially affected to give feedback: Yes
Culture Suitability: Middle Eastern-like

Statement: "I think emails are good if you want someone to actually sit down and write a couple of sentences about how they feel about your service popups and other 'push' mechanisms intrude & interrupt flow."

Goals: Impact the software with his feedback + raising others awareness about the used software + being socially recognised.

Behaviour to feedback:

Jack as a researcher spends most of his time on the computer working on his research as well as networking with other researchers. **[Motivation]** Jack believes in the power feedback in general and its positive impact. He is a very positive person towards feedback requests and reminders coming from software application.

[Method] However, he prefers to be asked for feedback in an offline way (i.e. through emails or text messages).

[Discouragement] He believes online feedback request (i.e. popups) could somehow be intruding and interrupting especially when he is working on his research and deeply thinking.

[Privacy] In addition, Jack is always concerned about his privacy and therefore he does not accept to implicitly collect feedback from him (i.e. tracking his usage of the software). **[Motivation]** In addition, Jack is a socially motivated feedback provider and his willingness to give feedback is positively influenced by one or more of the following social factors:

- **Social recognition:** He likes to be socially recognized for his valuable and trustworthy feedback which he believes could help others and raise the social awareness about the software in use.
- **Volume of already given feedback:** He gets enthusiastic to give feedback when there is high number of feedbacks already given on a software. This means to jack the software is popular and deserves his feedback.
- **Visibility of other users' feedback:** Jack also gets more interested to give feedback if he is able to see other users' feedback on the software first and then having the option to accept/reject to give feedback.

Fig 4. Jack: Privacy fanatic and generous.

Mark



Profile: Passive and stingy
Age: 50
Gender: Male
Job: Business man
Socially affected to give feedback: No
Culture Suitability: Neutral

Statement: "I find it problematic, hindering and unprofessional to send me any kind of feedback requests. If I'm not happy with something I will go to their website and complain right to them".
Goals: Get my voice heard when I need.

Behaviour to feedback:

Mark is a business man and he spends a lot of time on his computer working on his business. He holds a very negative view about feedback request coming from software applications. He does not have the time to be responding to feedback request due to his heavy workload.

[Discouragement] Mark thinks feedback request coming from software applications can waste his time and he doesn't tolerate to be asked for feedback at all (whether it's online or offline feedback request). In fact, he thinks that feedback requests that interrupt him while he is working are an impolite way to get information out of him. Since Mark doesn't tolerate to be asked for feedback at the first place, he is not affected by any social factors to give feedback at all (i.e. social recognition does not make him happy to give feedback).

[Method and Motivation] However, Mark believes that there should be a channel for him to deliver his opinion whenever he likes by making him able to submit his feedback on a voluntarily base and without being proactively asked by the software (i.e. through a contact us form).

Fig.5. Mark: Passive and Stingy.

Richard



Profile: Loyal and passionate
Age: 18
Gender: Male
Job: High school student
Culture Suitability: Neutral

Statement: "If I'm passionate about something, can't stand negative reviews about it. I would always defend it. As simple as that"

Goal: To feel better when defending and praising what he is passionate about.

Behaviour to feedback:

Richard is a high school student and he is highly passionate about his new smartphone. His passion makes him blind to any drawbacks of his smartphone. He is not a big fan of the idea of being asked for/reminder to give feedbacks by software applications.

[Method] However, when it comes to something he loves he happily respond with a positive input regardless of the way he is being asked for the feedback (i.e. offline or real-time)

[Motivation] The main motivation that drives Richard willingness to give feedback is his passion and loyalty about certain product/software. **[concerns]** However, the quality of his feedback can be questionable since he tends to exaggerate in praising and defending what he loves.

Fig. 6. Richard: Loyal and passionate.

Sara



Profile: Incentive Seeker
Age: 28
Gender: Female
Job: Supermarket cashier
Culture Suitability: Neutral

Statement: "what's for me in it?, In fact, I wonder why would people give feedback for free?"

Goal: To win tangible incentives.

Behaviour to feedback:

Sara is a supermarket cashier and she highly believes in tangibly rewarding customers for their loyalty (i.e. customers win a free product after certain visits to the supermarket). She thinks the same applies to feedback request coming from software applications.

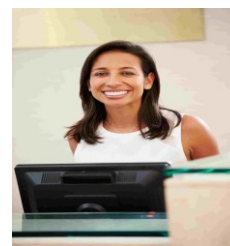
[Motivation] She argues that her the effort and time she spends giving feedback should be tangibly rewarded.

[Method] As long as there is an incentive, she is happy to respond to feedback requests regardless of the way she is being asked for the feedback (i.e. offline or real-time method).

[Concerns] However her response would be mostly positive and not well thought. This is due to her desire to get the incentive no matter how the feedback she gives looks like. This can have a negative effect on overall reputation of the software/product due to the low quality feedback that doesn't objectively represent her experience.

Fig.7. Sara: Incentive Seeker.

Hana



Profile: Perfectionist/complainer
Age: 24
Gender: Female
Job: Hotel receptionist
Culture Suitability: Neutral

Statement: "I'm perfectionist and I always seek perfection, If I tiny thing is wrong then of course I will speak"

Goal: To express her disappointment and sometimes ability to criticise+ seeking perfection.

Behaviour to feedback:

Hana is a hotel receptionist and her job requires her to seek perfection due to the size of criticism she receives from the hotel guests.

[Method] She wouldn't mind to be asked for feedback by software applications and she would always reply but mostly with a negative response regardless of the way she is being asked for feedback (i.e. offline or real-time method). She is a very picky person and never get satisfied no matter how good is the provided software/service.

[Motivation] The main motivation that drives Hana willingness to give feedback is her desire to achieve perfection and her ability to criticise anything.

[Concerns] However, the quality of her feedback can be questionable since she tends to exaggerate in criticism which could eventually result in an exaggerated harm to the software/product.

Fig.8. Hana: Perfectionist/complainer.



Profile: Impact seeker
Age: 29
Gender: Female
Job: School teacher
Socially affected to give feedback: No
Culture Suitability: Slightly Western-like

Statement: "The benefits of my feedback are always not clear to me as a user."

Goal: To consider her feedback and see the impact of it on the software.

Behaviour to feedback:

Amy is a school teacher and spends a great deal of time on the internet reading and researching educational related topics. She is not a big fan of the idea of being asked for/ reminded to give feedbacks by software applications.

[Discouragement] She does not believe her given feedback is going to be considered or lead to any changes/improvements on the software. She does not even get influenced or motivated by any social factors to give feedback (i.e. visibility of others feedback on the software doesn't really make her want to give feedback).

[Method] However, sometimes she can be tolerant to online feedback request (i.e. showing her a feedback popup dialogue while she is using the software).

[Discouragement] This is due to the fact that she doesn't accept the idea of having her email inbox filled with feedback requests or feedback reminders.

[Motivation] She tolerates the online ones since she has the control to respond or dismiss it at only one click sometimes. In conclusion, Amy can act more positively to feedback request if her feedback is considered and she can see its impact on the software.

Fig.9. Amy: Impact Seeker

Experts provided insights on each of the seven developed personas. Expert commented on Linda's behaviour and representativeness of the user group she encapsulates as *"I can absolutely see that's a common behaviour type and a mental approach to it, yes, that's a clearly identifiable set of individuals, heavy user of social software, considerate view about giving feedback and how it helps individuals and her place in the social network"*. Another expert reflected on her behaviour as a growing trend especially with social media websites such as YouTube, Facebook and Twitter. Experts also commented on Jack's behaviour as one of current observed behaviour of users to feedback requests especially when it comes to privacy concerns. The expert believed that software companies nowadays are not doing good job of explaining how feedback is used and collected which can trigger a privacy concerns to some people. This can eventually harm the software and people's trust in it.

In relation to Mark, an expert commented on Mark's behaviour and representativeness of the user group he encapsulates as *"Yeah, I'm Mark. Absolutely. The method Mark prefers [which is passive?] is really useful for business professionals instead of proactively asking them for feedback"*. In addition, one expert believes Sara is the person who does not really want to give feedback but will do so for the sake of the incentive. The only problem is that the quality of her feedback is always questionable since the motive

behind it is only the desired incentive. In relation to Hana, an expert indicated that Hana's group of users creates troubles to feedback collectors as they would give negative feedback which is not necessarily a good reflection of the quality but only their innate desire to criticize and optimize.

Another expert commented on Richard's behaviour as *"a lot of people are like Richard, no matter what you do, they're still going to love your brand, and they're still going to engage with the brand. Once they are so in love with that brand, they would do anything for it -- even if that brand really annoyed them"*. In relation to Amy's persona an expert believes that software companies are paying enough attention to close the loop with their users and keep them inform about how their feedback impacted the software. Ideally they should say to their users *"you asked us this, we've done that, job done and there isn't nearly enough of that done, it's still into this blackness"*. However, people give feedback, nothing seems to happen and this is why users or costumers lose interest in the service.

Looking at the previous personas, one can observe that some of the personas share similar characteristics. However, this should not mean they should be catered for similarly by the adaptive feedback acquisition. For example, Hana, Sara and Richard share the same characteristics with regard to the feedback method they respond to. However, each one of them has different motivations to give feedback which impact the quality of their given feedback. We emphasize that the adaptive feedback acquisition should cater for these nuances regardless of the shared characteristics among personas.

IV. PERSONAE'S FOR FEEDBACK ACQUISITION DESIGN

Experts identified some the benefits that the previous personas can offer to software engineers when adopted to inform the design of an adaptive feedback acquisition. These benefits are as follows:

A. Engagement

Several experts believed in the power of the previous personas to engage software engineers with the design of the feedback acquisition. This is perhaps due to the nature of the developed personas in which fictional information make them more interesting and attractive. An expert commented *"I assume they are very engaging and fun to work with. The picture and other profile information makes you feel you are working with a real person. This is really different from working with only dull descriptions about users"*.

B. Discussion

Generally speaking, personas are highly powerful to stimulate discussions among the design team [13, 14, 15]. Experts also believe the introduced personas can lead to fruitful discussions among the design team of an adaptive feedback acquisition. This discussion can ultimately lead to a better understanding and identification of persona behaviours to feedback acquisition. An expert commented *"I would use these personas to understand the users' behaviours to feedback acquisition. Actually I find it a good way to stimulate discussion and help designers better understand their users"*.

C. More efficiency in identifying requirements

Identifying users' requirements and preferences on feedback acquisition is a highly challenging task [6, 7]. The experts' point of view suggests that the introduced personas offer a suitable solution to address this challenge. This is illustrated in one of their comments *"If I put my software engineer hat I would say, using these personas could save me a lot of time and effort to identify users requirements and preferences to feedback acquisition. Different people have different characteristics, and it depends on what your software is targeting. If it's targeting Linda, then your feedback acquisition mechanism would look different from Mark. Depending on these different behaviours represented by the personas, you could derive your software requirements"*

D. Release your thinking from your own mental model

Personas can noticeably reduce designers' unconscious bias when designing software. It helps them avoid being limited to their own mental models about how users would be like [13] [14, 15]. Some experts believe the introduced personas can help software designers realize how people are different from themselves when it comes to feedback acquisition. Generally, this can positively impact the success of software since its designers were able to limit the effect of their own mental models on software design. An expert commented *"I can see how those personas can aid individuals realizing how the users/customers are different from themselves in the context of feedback acquisition. They would open the process up enormously because the danger is we all pursue things on our own, preconceptions, and of course, mine is different than someone else's is"*

E. Validation

Software validation is vital phase that determines software success or failure. Personas are shown to be useful for software/product validation purposes in which proposed designs, features and solutions can be reviewed and evaluated against the needs described by an individual persona [13, 14] [15]. Experts agreed that the introduced personas can be highly useful to validate the developed feedback acquisition against the behaviour and preferences of the persona it was developed for. An expert said *"validation is always a bit hit and miss. I think these personas would be definitely a useful tool for validating your developed feedback acquisition. If the developed acquisition is meant to fit Jack but it doesn't seem to fit his motivations then certainly there is something wrong"*

V. PAFA: PERSON-BASED METHOD FOR ADAPTIVE FEEDBACK ACQUISITION

One open question is that, as a software engineer, how would we use the previously offered personas to inform the design of an adaptive feedback acquisition? To answer this question and in the light of the experts' opinion, the literature review we did on Persona-based design as well as our experience obtained through the previous empirical studies we conducted in relation to feedback acquisition, we introduce PAFA, a **Persona-based Method for Adaptive Feedback**

Acquisition. PAFA goes through the following phases (see Fig. 10):

A. First phase: Personas to Scenarios

Personas could be used as foundation to build scenarios which is seen as a natural practice for Persona-based design [9]. Carroll, an interaction design theorist, defines a scenario as a story that has a setting, agents or/and actors who have goals and objectives, and a sequence of actions and events [28]. Several experts believe that scenarios could be a complementary element to the developed personas to improve software engineers understanding about each persona's behaviour as well as the requirements/preferences.

Scenarios add a more detailed description about the personas which give a clearer view of its requirements. An expert commented in this regard *"Jack (the persona) has a rich story that I can rely on to generate multiple scenarios out of it describing in more details his behaviour in different context when he is being asked to give feedback. As you know scenarios will have some actions, and tasks within them. So, these actions and tasks within those scenarios could lead to better identification of Jack's requirements"*. On the other hand, personas can be used to bring life to scenario-based design generally. Given that scenario-based design has actors or agents, these actors or /and agents are typically not defined in a way that promote generative and interactive engagement among designers [13].

In this first phase of PAFA, software engineers should start the design process with deriving multiple scenarios from each persona following the rules for scenario authoring as discussed in [43, 44, 45]. Scenario should also be authored with respect to the persona's behavioural aspects when applicable such as the persona's goals, motivations, methods, concerns and privacy preferences. This adds a more detailed description about the personas which gives software engineers a better understanding about the various possible behaviours of users as well as discovery of their requirements/preferences or goals [31]. For example, Amy's willingness to give feedback would differ in case the request is for software in its trial stage as this indicates that her feedback could have her desired impact.

B. Second phase: Scenarios to Goal modelling

Goal modeling is a widely used technique during the early phases of software requirement engineering. It improves the efficiency of the requirement engineering process and offers modeling concepts to represent the rationale of social and technical actors in socio-technical systems through notions like goals, softgoals, decomposition, actors and their interaction [30]. Goals are intentions and goal models also capture the rationale of actors which nicely fit to the description of personas [34] and their elaborations as scenarios.

Scenarios authored in the previous phase can aid software engineering to achieve a better extraction and identification of each personas goals, softgoals, the relationship between the identified goals and softgoals as a basic step to enable the expression of preferences and the qualification between the

alternative ways to fulfill goals. Ultimately, this leads to the creation of a goal model that gives a clearer visual and structured view of each persona's goals and the alternatives to reach them. For example, one of Jack's goals to give feedback is to raise others awareness about a certain software. However, privacy is a softgoal for Jack that, if not respected through at least one of the alternatives to achieve raising awareness goal, can lead to rejecting feedback requests. Using scenarios to develop goal models is indeed a common practice in requirements engineering as discussed in [34, 35].

C. Third Phase: Goal model to use-cases

Although goal modelling provides software engineers with a better understanding of each persona's goals and softgoals and the different alternatives to reach those goals, it is limited, and probably not meant, to capture the interactions of an actor (in this case persona) with the software. This can lead to missing important information about persona's requirements. To tackle this issue and in the light of the goal models developed in the previous phase, software engineers should derive use-cases to capture the interactions of each persona with the software. This can be achieved following approaches discussed in [33, 32] which advocate that combining goal models with use-cases is indeed a powerful way towards a better requirement engineering process which minimize the risk of overlooking some of users' requirements when the design phase starts.

A use-case "describes a sequence of actions a system performs that yields a result of value to a particular actor" [26]. Use-cases are simple but useful tool and they are part of the Unified Modelling Language (UML) and its methodology [25]. In practice, use-cases could make the description of users and how they would interact with software for feedback more structured, i.e. the use case diagram and narratives [27]. For example, for Mark, the use case of Supplying Feedback would have a flow in which all the control is given to him as a primary actor. However, for Linda, the software could be a primary actor for such a use case which could autonomously execute certain actions, i.e. issuing the request and showing her social recognition level.

In this phase software engineers are also recommended to review the resulted requirements specification, i.e. the goal models and the use cases and their narratives, against the needs of the initial personas. This can help minimizing the risk of missing requirements at later stages which can negatively impact the success of feedback acquisition hence the user experience and the software.

D. Fourth phase: Adaptation Engineering

In the previous steps, personas were used to originate scenarios and these led to a set of goal models which in turn led to define use cases (the diagram and the narrative) on how the interaction between the users and the software for feedback acquisition should take place. In this stage a commonality and variability analysis amongst these interactions should take place. This would result in some form of variability model of feedback acquisition characteristics visible to the user, e.g. a Feature Model [39]. These models

capture the variability and commonality of the features of the different personas and allow configuration and adaptation to take place in one or more of the following styles:

1. Staged configuration

The concept of staged configuration was suggested by Czarnecki et al. [36] for a better commonality and variability analysis. Staged configuration is achieved by specifying a family member in stages where each stage eliminates configuration choices, which can reduce the complexity of feature selection. This process can be done using Feature Models where the configuration choices available in each stage are defined by separate feature models.

Software engineers (enlightened by the previous phases and in collaboration with other stakeholders, e.g. domain experts and business administrators) can conduct a multilevel configuration on feedback requests design. For example, the choice to include certain functionalities or a feature could be decided according to the nature of the domain and business needs and preferences. A feature or a collection of features may be only applicable in a certain business or technical context and under certain conditions [40]. Privacy-sensitive software, e.g. health related, will maximize privacy issue and thus those features related to social recognition (meant to meet the requirements of people like Jack) should be just optional or subject to confirmation from the users.

Some other features could be then decided by the clients, i.e. the software or the product company, based on factors like their need for volume and/or quality. For example, this would result on decisions on the incentives features meant to meet the requirements of people similar to Sara to get just tangible monetary return. Such a staged configuration will enable the gradual customization of feedback request till it arrives to users.

2. Users direct input

This can be done by allowing the users to customize the variable design of feedback requests. They can do that through the personas themselves where they can select the persona that reflects them the most and customize it the way they wish to provide feedback. For example, common personas are represented to user Y when installing software X for the first time. User Y then have the option to select the persona that he feels it somehow reflects his behavior to feedback requests mainly by looking at the brief statement describing them. User Y is also able to customize the selected persona through an interactive interface (i.e. priorities their goals by pulling the highly important one to the top of the list, drag and drop some aspect from another persona to their selected persona, adding their own pictures and names/nicknames to the persona, etc).

This could make users' experience more enjoyable as well as impact the success of the feedback acquisition since it is designed based on trustworthy information coming directly from the users. More lessons on how to design such an interactive approach can be borrowed from HCI approaches to interface design to help software developers employing such

an approach. That is, the design of the interaction with users should be itself engineered and its usability tested.

Although this approach could be efficient to cater for the commonality and variability among users, software engineers need to be cautious about how the personas are presented to users. Users might reject a persona that highly represents them just because they are younger or of a different gender, etc. This is a challenge to handle in the use of personas in general as a user-friendly customization tool.

3. Personality questions

Another way to do the configuration of feedback requests is the use of personality questions [29]. Users' answers to these questions can map them to the persona or personas elements they belong to, e.g., the behavioural aspect that makes them different to others represented by the same persona. These personality questions can be introduced to the users during the installation process of the software or before they are being asked for feedback. For example, software engineers can use Myers Briggs personality questions [29] to drive a set of personality questions in relation to feedback acquisition, and then asking users to answer them.

This can be a helpful way to infer users' behaviours and then mapping them to potential personas, e.g., users who turn to be extraversion based on their answers to the personality questions can be mapped to personas that represent socially active users such as Linda. However, this approach to mapping users to feedback personas introduces many questions about the type of questions to be asked, the number of questions, the way of asking, the way of inferring users' types, the accuracy of the behaviour inference, etc. This indeed opens the gate for a further research in this area.

4. Social Adaptation

Social Adaptation is defined as a system's autonomous ability to analyse users' feedback and choose an alternative configuration which is collectively shown to be the best for satisfying requirements in a certain context [1]. The concept of Social Adaptation can be itself applied to customize and adapt

feedback requests. . Users' given feedback about the software behaviour would then include their feedback on the feedback acquisition request itself. This provides a valuable source of information to discover how a certain acquisition method fits a group of users. This valuable information can be then utilized to adapt the acquisition method. Social adaptation could be advanced by utilizing techniques like collaborative filtering. .

Collaborative filtering is one of the techniques used by recommender systems to provide recommendations or predictions to the user depending on the opinions of other like-minded users [37]. The motivation of collaborative filtering is the idea that people usually get the best recommendations from other people with similar tastes to themselves.

Collaborative filtering can potentially benefit and help in discovering commonality and variability among users behaviour to feedback acquisition. For example, If X and Y are two like-minded users represented by Jack (the persona), then a prediction about Y's preferable social factor can be made based on X's preferable social factor.

5. Final phase: Evolvement

This phase is indeed an important phase to close the loop, evolve and sharpen the initially created personas enlightened by the discovered information in the previous phases due. We recommend software engineers to use this valuable information to enhance the personas, making them more representative and detailed and perhaps add or eliminate some of them.

VI. DISCUSSION

The literature contains several approaches on the use of personas to inform the design of software applications such as [41, 42]. However, the majority of these approaches do not noticeably employ the power of personas to directly inform the actual design of the software and limit their usage to the abstract level as communication tool. This led to a gap and lack of tractability between personas and the actual design thus the underestimation of personas power.

The novelty and power of PAFA comes from its ability to combine powerful software engineering and user experience

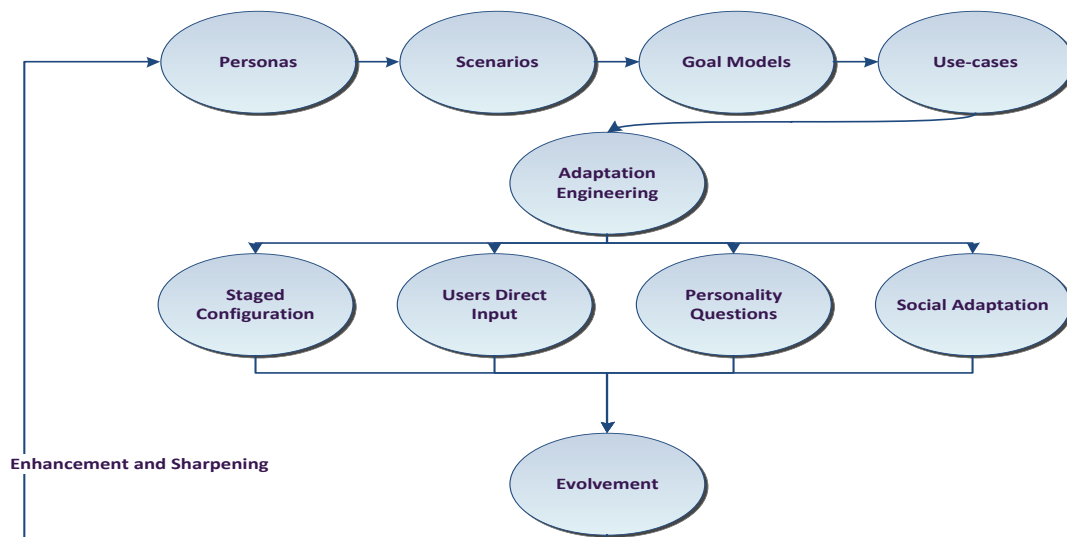


Fig.10. The PAFA method for designing an adaptive feedback acquisition.

methods to systematically inform the design of an adaptive feedback acquisition. This reduces the gap between personas and their impact on the design, increases traceability and shows the real power of personas as a design tool. This can ultimately lead to maximize users' satisfaction and software's success as discussed in [5, 6].

On the down side, Personas have been criticized mostly because they could be too fictional and have no clear relationship to real users' data and therefore any data gathered cannot be considered scientific [9]. However, in this work persona creation is highly based on data of actual users gathered from empirical studies we previously conducted [6, 7] (except for some accessorial data which were only used to bring life to the personas). Also, our utilization of personas is not to restrict users to them but rather to initiate a discussion between the stakeholders involved in the feedback acquisition process. This means that the refinement of these personas, creation of others, and eliminating some of them would be still possible within the context and throughout the life time of a certain project or software.

This also means that the refinement and evolvments of these personas would most likely be different amongst projects depending on the specifics of each project and also the nature of users' involved, products and services which are the subject of feedback, etc. In addition, PAFA does not restrict software engineers to adopt all the seven personas in the design of the feedback acquisition. Stakeholders should decide on the personas they need to cater for in their feedback acquisitions. For example, a certain company might decide not to cater for Sara (incentive seeker) in its feedback acquisition to avoid low quality feedback.

In principle, the preferences of a service provider would decide their selection of the personas to support. It may also lead to creating variation of the introduced baseline personas to fit their definition of a relevant user or client. This may require preferences on the costs, the speed of getting feedback, the need for high quality feedback, targeting certain age bands and culture backgrounds, etc. We emphasize that such decisions are taken alongside PAFA and not only at the initial stage of selecting personas to cater for. This will become clearer when presented in the variability models (i.e. goal and feature model), where the choice of the technique is subject to such preferences.

In addition, we emphasize that personas should be clearly communicated to software engineers to ensure they clearly understand how to use them. For example, they should be aware that some fictional data in the persona (i.e. the picture or name) are only to bring life to it and make it memorable and should not impact the design of the software. Similar precautionary procedure should be followed when introducing personas to users who may simply reject being similar to a certain persona because of the picture of the age.

Additionally and in contrast to the benefits of personas mentioned previously, some experts believed that the use of personas could limit the thinking and imagination of software engineers to only the set of proposed personas and could result in them not considering other users who were not represented

by personas. One of the experts commented *"the only thing that concerns me about personas is that, you perhaps start to isolate your thinking and segregate things a bit too much. It's probably not worth relying on thinking, 'this is the 7 type of people we've got and that's it, that's the end of it'. So it probably could isolate your thinking a little bit and maybe lead you down the wrong track"*.

We also do not claim our personas cover all users' types to feedback acquisition and further research in this area could result in more or less personas. We believe our personas cover the most common and observed types of users' behaviours to feedback acquisition based on the studies we conducted [6] [7] as well as the expert survey we undertook. These personas could create different scenarios as explained in our PAFA methods and thus are not only meant to stereotype users but rather to generate the space of variability and commonalities on how feedback should be requested and obtained.

Although we have carefully followed the principles in developing the personas and conducting the expert interviews, our work would still have three main threats to validity:

- While the methodology was effective in identifying users' behaviour and creating personas to reflect their behaviour with regards to feedback acquisition, it is possible that the personas did not capture all the aspects and factors that can affect the users' behaviours it represents.
- Our personas were validated from an expert point of view only. The users have not contributed to the validation and creation process. Allowing users to contribute to the validation of the personas can result in a more robust set of personas.
- A common threat to the validity when designing an interview is whether the questions were understood by all experts as intended. This threat was somehow addressed as the interview script went through iterative revisions and modifications by two research members to ensure clarity.

VII. CONCLUSIONS AND FUTURE WORK

To conclude, this paper provides a clearer view and a deeper understanding of users' different behaviours to feedback acquisition represented in seven personas of users' behaviour to feedback acquisition. This highlights the need for an adaptive feedback acquisition to cater for these various behaviours. Additionally, the paper gives a clear view on how the introduced personas can benefit software engineers when designing an adaptive feedback acquisition. PAFA method was also introduced to adopt the proposed personas to inform the design of an adaptive feedback acquisition.

Our future work will elaborate on the PAFA method and apply it on case studies aiming to refine it more and propose tools to support it. The method relies on some novel techniques which have not been used in the context of feedback acquisition before such as the staged configuration, collaborative filtering and personality questions. The investigation of the method will imply investigating these elements.

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