Affective Adaptation of Social Norms in Workplace Design

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Abstract

Open-plan offices are common in today's organisations. These types of workplaces require people to share a common space, where violation of (implicitly or explicitly stated) social norms can cause instances of incivility. If nothing is done to avoid these situations, bad feeling can lead to diminished productivity and cooperation, and, in the long-term, to more serious problems, such as conflict and aggression.

A critical review of literature shows the effects of workplace incivility and the need for an internal reparation mechanism. Inspired by convergence of pervasive, adaptive and affective computing, we have designed and developed a self-regulatory platform for successful collective action, based on participatory adaptation and fair information practises, which we called MACS. MACS addresses the problem of incivility and aims at improving the Quality of Experience in shared workplaces.

This thesis presents all studies that led to the development of MACS. Through the analysis of an online questionnaire we gathered information about incivility in shared workplaces, how people deal with those situations, and awareness about uncivil self-behaviours. We concluded the main issue while sharing a workplace is noise, and most people will try to change their own behaviour, rather than confronting the person being uncivil.

MACS's avatar-based interface was developed with the purpose of heightening self-awareness and cueing the appropriate social norms, while providing a good User Experience (UX). Avatars created to people's image, rather than photos, were used, to keep MACS's tone light and relatively unintrusive, while still creating self-awareness.

MACS's final version went through UX testing, where 6 people were filmed while performing tasks in MACS. The intended work-flow and user interfaces to support the smooth passage of the work-flow have been validated by the UX user testing. There is some preliminary evidence suggesting apology will elicit empathic responses in MACS.

Finally, this thesis proposes guidelines for workplace design, which are founded on participatory creation and change of social norms, and ways to make sure they are enforced. In this sense, MACS can also be seen as a prototypical example of a socio-technical system being used as platform for successful collective action.

Declaration of Originality

I herewith declare that I have produced this thesis without the prohibited assistance of third parties and without making use of aids other than those specified; notions taken over directly or indirectly from other sources have been identified as such. This thesis has not previously been presented in identical or similar form to any other British or foreign examination board.

The thesis work was conducted from 2008 to 2013 under the supervision of Dr. Jeremy Pitt at Imperial College London.

London, September 2013

Copyright Declaration

Aos meus pais, Ana Maria e Agostinho,

ao meu avô Mino e à memória da minha avó Angelina,

às minhas irmãs Ana e Raquel, cunhado Pedro, e sobrinhas Catarina e Daniela,

à minha tia/madrinha Cândida e tio Orlando.

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Introduction

1.1 Background

Many of today's workplaces comprise an open space with several employees and computers. People need to share an office space and, very often, situations of incivility happen. If not addressed properly, these situations might lead to more serious problems, such as conflict and aggression [3].

The design of workplaces, namely the physical arrangement of people and machines, has an active influence on work-related issues, such as productivity and efficiency. This arrangement can be an inhibitor or a facilitator to more social interactions [120]. It is a goal of today's organisations to find ways to effectively use office work environments as means to improve worker performance and quality of experience. Moreover, group performance has become a main question for businesses that rely on collaborative work to achieve the organisational goals [31, 88]. Thus, it is essential that office environments are designed with the purpose of providing dynamic, user-friendly space [142].

Pervasive computing aims at creating digital environments that are sensitive to human needs, and adapt and respond accordingly [147]. In these environments, pervasive applications become ideally invisible, which is made possible by their degree of integration and need for minimal human input. For all this to be achievable, systems and devices that are part of the digital environment need to be context-aware and use this context-awareness smartly. Pervasive computing requires systems and devices that perceive context in an accurate way, followed by intelligent control or action between machines and humans [147].

Evidence from several areas of research, such as, for instance, medical studies and social support groups, suggest that people reveal more socially undesirable information about themselves in Computer Mediated Communications (CMC) than when compared to the equivalent face-to-face interaction [87]. It is therefore expected that often, when people break the social norms of the workplace, their colleagues won't confront them. If this situation persists it might lead to a bad work environment, since it represents a break in the general trust that everyone will follow the norms. By not confronting people who break the norms, who might not even be aware they have broken them, the remaining people in the workplace don't give them a chance to apologise and/or explain themselves. And as Vasalou et al. argue, when an offender has the opportunity to repair the action (in this case, whatever broke a social norm), the victim's trust can be restored [162].

We believe people's interactions in workplaces could be improved by allowing them to define the social norms they must abide by and pervasively adapting those norms; and by enabling people to deal with episodes of incivility amongst themselves and their co-workers, without the need to resort to managers.

1.2 Problem statement

Behavioural norms can be found in every community and culture [64, 70, 75], nonetheless being expressed differently in each of the contexts they appear in. Observing rules of interpersonal conduct enables people to live and work together [128].

Workplaces are no exception and norms exist so that people can share office spaces and still be able to successfully perform their work. These norms exist, regardless of being officially imposed by the company, or mutually agreed on, between co-workers. According to Hodgson, institutions are "durable systems of established and embedded social rules that structure social interactions" [77].

However, norms simply say what people "must, must not, may, can and cannot do" [37], and breaking norms is always an available option, though associated with a risk of punishment. If this risk is low, the predictability and stability of a situation are reduced, and instability can grow over time. If, nonetheless, the risk is high, people expect everyone to behave according to the rules [122, 123]. So norms are frequently broken, which can cause disruptions to the normal work flow. And very often, although causing damage to

the personal work and overall productivity of a company, nothing is done to avoid norm violation and to punish people who break the norms.

This can potentially lead to damaging the relationships between people who share a workplace, creating a bad working environment.

Bullying, abuse, conflict, aggression, mobbing, social undermining, sexual harassment and incivility are all examples of workplace deviance, with different levels of intensity. But they share a common ground: They are all expressions of disrespect among people who work together [100]. Incivility is "a low-intensity deviant behaviour with ambiguous intent to harm the target, in violation of workplace norms for mutual respect" [3]. It includes "the exchange of seemingly inconsequential words and deeds that violate conventional norms of workplace conduct" [127]. Leiter [100] considers it to be a contemporary workplace crisis, and the entry level form of workplace mistreatment. The fact that the intent to inflict harm is ambiguous means sometimes people will be uncivil with the clear objective of insulting or humiliating the target, but others, their uncivil behaviour might be caused by "irritability, fatigue, carelessness, or ignorance of social norms" [89].

Porath and Pearson [136] have been studying workplace incivility for the past fourteen years. In this time they have administered questionnaires, run experiments, led workshops and spoken with several types of professionals about how they've faced and handled incivility. They have collected data from more than 14000 people in order to assess the prevalence, types, causes, costs, and cures of incivility at work. They found that workplace incivility is on the rise: 98% of the studied workers have reported experiencing uncivil behaviour; and in 2011 half said they were treated rudely at least once a week, which is up, from a quarter in 1998. They concluded that incivility is expensive – several companies they've worked with have calculated incivility costs them millions of dollars a year; and that only few organisations recognise or take action to reduce it.

Besides the financial consequences for companies, incivility also has repercussions for the people it targets. It affects their mental and physical health [43, 102], and their personal life [102].

In summary, workplace incivility is a low-intensity form of workplace deviance, that is difficult to detect and resolve. However, it is very harmful for companies, as:

- it can be the initial stage of, and lead to, more serious kinds of deviance;

- it has consequences for the personal life and health of people who are victims of incivility;
- it has repercussions on the target's work effort, creativity, motivation and general satisfaction in the workplace;
- it leads to absenteeism, tardiness and people leaving their jobs.

Therefore, it is essential for researchers to find ways in which to reduce the negative effects of workplace incivility [116].

Based on previous studies about social support as an extenuating factor for stress [32, 95], Miner et al. [116] argue social support is a mitigating factor of the relationship between incivility and negative outcomes. Social support has been defined as "information that leads a person to believe he or she is cared for and loved (...) esteemed and valued (...) and belongs to a network of communication and mutual obligations" [95]. They suggest that people who are more socially supported may not feel the negative outcomes of experiencing incivility, to the same extent as their less supported counterparts.

1.3 Proposed solution

The previous section has explained how incivility is a serious problem in workplaces, that has damaging repercussions for the company. Workplace incivility is, therefore, the problem we propose to solve with this thesis.

The solution we present for addressing this problem, is MACS – M—'s Affective Conditioning System – a system that attempts to avoid, reduce and/or resolve incivility in the workplace, before an incivility episode escalates into a higher-intensity workplace deviance situation, e.g. conflict or aggression, and guidelines for workplace design. This solution is intended to avoid micro-managing, as the main idea is that incivility episodes are sorted out between stakeholders, and only as a last resort, is there need to involve higher management; and to provide social support, by providing a network of communication and mutual obligations, via the enforcement of the established social norms.

MACS was designed and developed taking into consideration employees' reputations, the social norms of each specific workplace – both evolving throughout time – and anonymous flagging of violations of those social norms. Additionally, it also implements concepts

of apology/forgiveness, by allowing people who violate norms to apologise for their behaviour, and in turn, the victims of that incivility episode, to accept that apology and forgive the offender.

We believe our solution (MACS and the guidelines) is capable of re-establishing and keeping the social harmony and the interactional connectedness in the workplace. The solution is explained in further detail in Chapters 5 and 6. Chapter 7 presents the studies conducted to evaluate the solution, in terms of:

- Conformity to Ostrom's principles for governing a commons [122] – a heuristic evaluation of our solution against the well-established Ostrom's principles has shown it fits in those principles.

- User experience – a user experience study, conducted by observing and filming users while they go through a script on MACS, has shown MACS is intuitive and easy to use and has validated both MACS's work-flow and the user interfaces created to support the smooth passage of the work-flow.

- Assessing MACS's impact on workplaces – field trials have been conducted in two different workplaces, to assess MACS's impact in terms of awareness of norms, awareness of own behaviours and creating a better working environment.

These evaluations have proved we have created a completely usable solution for addressing incivility in shared workplaces, with dynamic adaptation of social norms, that is easy and intuitive to use. It has the ability of creating self-awareness, awareness of other people's behaviours and awareness of the norms of the workplace, as well as influencing the behaviours of people who have broken the norms, therefore influencing the workplace's environment in a positive way.

1.4 Thesis organisation

This thesis is organised in eight chapters. This chapter presents an overview of the background for this work, states the problem and introduces the proposed solution and contributions of this thesis.

Chapter 2 offers an interdisciplinary analysis of the nature of the problem of incivility in the workplace, by reviewing the following topics:

- The psychology of workplace incivility: what is workplace incivility; in what way it affects people who have to share a workplace; and how it might escalate into more serious deviance types, such as conflict and aggression.

- Affect categorisation, according to different theories of emotion.

- The effect of affect in human interactions: How affect plays a critical role in cognitive processes in people and the way they interact with computers.

- Apology and forgiveness in human interactions and in computer-mediated communications.

- Interpersonal connectedness: the importance of sense of belonging in eliciting positive affect.

- Quality of experience in the workplace.

Chapter 3 presents the interviews and a questionnaire, which, along with the critical literature review that establishes the problem, highlight the requirements for an Information and Communication Technology (ICT) system to address the problem of workplace incivility.

We propose to converge affective, pervasive and adaptive computing to meet the requirements. These are described on Chapter 4 and are important for:

- Affective computing is important because we need to find ways to assess affective states and try to improve them.

- Pervasive computing is relevant, as it would be desirable to find ways to ubiquitously collect and analyse data, regarding, mostly, noise, which is the biggest problem in the workplace, and physiological signs of affective dissonance, which could point to situations where people are upset by incivility.

- Adaptive computing is essential, because social norms are set by people who will abide by them, but they aren't stable, as over time some norms might become obsolete or require change, and some new norms might arise. Therefore we use adaptive computing to reflect these norms' changes.

Chapter 5 describes the innovative platform developed to address the problem described in Chapter 1. This platform is called MACS. The chapter reports on MACS's design and architecture, its database and an overview of the way it was developed and implemented.

A different and very relevant part of MACS is its interface, described in Chapter 6. MACS's interface and interaction were carefully designed with the intent of providing the best possible UX. The use of avatars that represent each of the people who share a workplace was used intentionally in order to create self-awareness and recognition, while, at the same time, keeping the interface light. The chapter describes the sketches and low-fidelity prototypes created while designing MACS, which have led to the final interface, also presented. It also proposes guidelines for workplace design, that were based on MACS and Ostrom's principles for managing a commons [122].

Chapter 7 describes the user study conducted to evaluate MACS' UX, a heuristic evaluation of our solution against Ostrom's principles for managing a commons [122], and the field trials conducted in two different workplaces to evaluate MACS as a solution to address workplace incivility.

Finally, Chapter 8 sees the conclusions of this thesis, with considerations about limitations, future work and opportunities of development.

1.5 Contributions of this thesis

In this thesis we present an inter-disciplinary analysis of incivility, by conducting a critical review of literature of psychology on workplace incivility, and a survey on Quality of Experience (QoE) in the workplace, which have highlighted the main issues causing problems in shared offices, and how people prefer to deal with them.

We also present the design and implementation of an innovative "Affective Conditioning System", MACS, which converges elements of affective, pervasive and adaptive computing.

MACS has had a UX user evaluation, and insights from this evaluation, along with the Ostrom's principles for managing a commons [122] have led to the drawing of a number of design guidelines for deploying socio-technical systems in open-plan or hot-desked workplaces.

Our system, composed of MACS and the design guidelines, has had a heuristic evaluation against Ostrom's principles, which showed all relevant principles are covered by our solution. Therefore it can been seen as prototypical example of a socio-technical system being used as platform for successful collective action.

MACS has been evaluated on real workplace settings and has proven to be effective on the general awareness of social norms and of self-behaviours. MACS's full functionality has been used at these evaluations and most people reported MACS has improved their workplace environment.

The payoffs of combining, studying and implementing all these are:

- A better understanding of the design and implementation of socio-technical systems (i.e., computer systems which have to represent and reason with social and/or psychological constructs, in this case, both emotions and workplace rules),
- ergonomic guidelines for improved workplace design.

The following papers have been published throughout the course of this project:

Mónica Sara Santos and Jeremy Pitt. Emotions and Norms in Shared Spaces. In *Coordination, Organizations, Institutions, and Norms in Agent Systems IX*, pages 157-176, 2014.

Mónica Sara Santos and Jeremy Pitt. MACS – Affective Conditioning System for shared working environments. In *IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology (WI-IAT)*, volume 3, pages 57-60. IEEE, 2011.

Mónica Sara Santos and Jeremy Pitt. Affective conditioning, social cohesion and the office experience. In *CHI 2010 Workshop on Designing and Evaluating Affective Aspects of Sociable Media to Support Social Connectedness*, 2010.

Mónica Sara Santos. Social Cohesion and the Office Experience. In *Perada Magazine, Affective Computing*, 2010. Available from http://www.perada-magazine.eu/view.php?source=002871-2010-04-01, accessed April 2014.

Mónica Sara Santos and Jeremy Pitt. Ubiquitous Computing and Pervasive Adaptation of Social Norms in Workplace Design. In *Proceedings of the Symposium on Mental States, Emotions and their Embodiment, AISB 2009 Convention*, pages 32-35, 2009.

2

Incivility in the workplace

2.1 Introduction

This chapter will present the problem of workplace incivility, theories of affective categorisation and the effect affect has in human interactions. This will help explain the impact incivility has in the affective states of people who suffer from it. When people are victims of incivility they might experience negative emotions or feelings. If, however, following an episode of incivility, the offender apologises for their uncivil behaviour, this might elicit empathy and consequently forgiveness.

An apology is an expression of regret for wrongdoing, that can encourage forgiveness. Forgiving someone promotes positive affect, and it might help to repair an episode of incivility, so this chapter expands on apology and forgiveness in personal interactions and in computer-mediated interactions. The feeling of belonging, or interpersonal connectedness, also fosters positive affect.

Our hypothesis is that despite the fact an episode of incivility will have a negative impact on the person or people who suffer from it, a process of informing someone that they have broken the norms and allowing them to apologise for their actions, followed by forgiveness, will help to promote empathy, create positive affect and foster interpersonal connectedness, which, in turn, will improve the quality of experience in the workplace.

2.2 Psychology of workplace incivility

Behavioural norms can be found in every community and culture [64, 70, 75], nonetheless being expressed differently in each of the contexts they appear in. Observing rules of

interpersonal conduct enables people to live and work together [128]. Some institutions' durability is based on the fact that they can effectively create stable expectations of people's behaviours [77].

Today's organisations are characterised by fast-paced relationships between co-workers, often mediated by high-tech, asynchronous communications [3, 129]. All these can be facilitators for employees' mistreatment of one another, which can take various forms – bullying, abuse, conflict, aggression, mobbing, social undermining and incivility – but with a common ground: They all share expressions of disrespect among people who work together. Leiter [100] considers incivility to be a contemporary workplace crisis, and the entry level form of workplace mistreatment.

The prevailing and costly effects of workplace deviance are considered to be among the most serious problems organisations face today [14]. Workplace incivility is a kind of deviance that although occurring regularly in many organisations, is not easily recognisable and addressed [126, 129]. The offender's intent to harm is ambiguous, as it may be perceived differently from different perspectives – that of the offender, the victim and other observers. And the instigator might be violating norms without intent to do so. The fact that the intent is ambiguous is very relevant to the definition of incivility, as it distinguishes incivility from more serious forms of workplace deviance, such as verbal aggression or bullying. Workplace incivility is therefore defined by Andersson and Pearson as "a low-intensity deviant behaviour with ambiguous intent to harm the target, in violation of workplace norms for mutual respect. Uncivil behaviours are characteristically rude and discourteous, displaying a lack of regard for others" [3].

Given its low-intensity quality and the fact it is not illegal, many companies fail to recognise incivility and most managers are ill-equipped to deal with it. Employees are trained to recognise and deal with other forms of mistreatment, organisations have policies and mechanisms to address them and laws back them up, but the same does not happen for incivility [129].

However, when an incivility episode happens it might not be an isolated incident. There are three potential outcomes for the people involved in the episode: They may continue to be uncivil to each other through other acts of incivility; they may increase the intensity of the offence; or one of the parties may choose to walk away [129]. If the choice is to increase the intensity of offences, each round of disrespect may become more dramatic and aggressive, leading to what can be defined as an incivility spiral [3, 128]. The

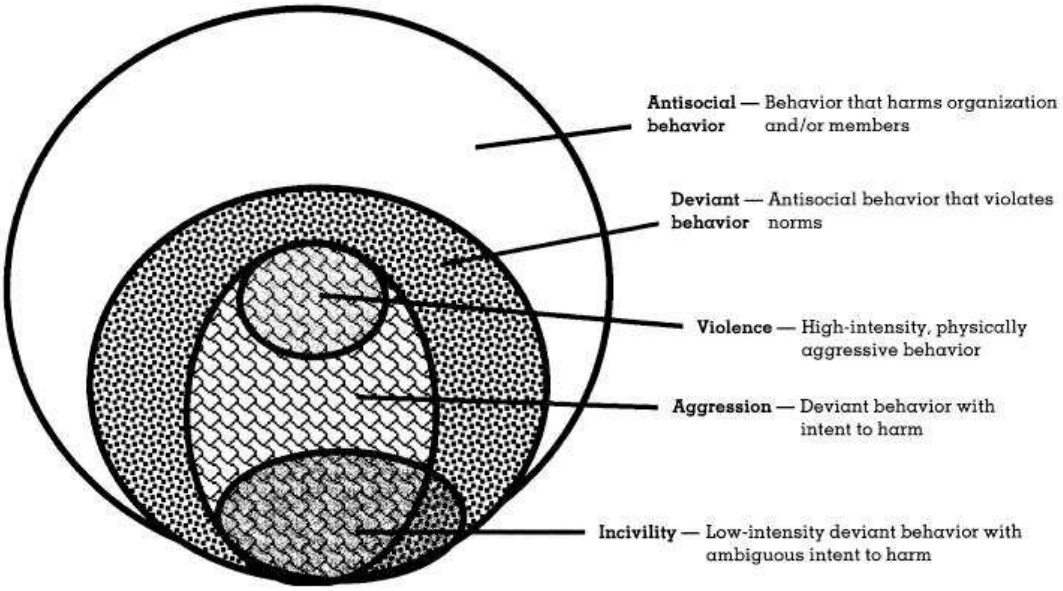

Figure 2.1: Incivility and other forms of mistreatment in organisations (taken from [3]).

occurrence of the first violation of a norm creates negative affect and a feeling of perceived unfairness, and motivates the victims to reciprocate [15, 17, 51, 94, 154]. And the most common means of releasing negative affect in this kind of situation is to reciprocate with further unfairness [51, 94].

The incivility spiral might stop when one of the parties involved chooses to stop retaliating, or when one of the parties apologises, denies intent to harm and/or offers an excuse [3].

Workplace incivility has serious consequences, that include work-related disturbances, mental and physical health problems and personal life repercussions.

Work-related disturbances caused by incivility include diminished productivity, performance, creativity, motivation, work satisfaction and helping behaviours [36, 85, 101, 102, 129, 148]; and increased stress [101], turnover intentions [102], withdrawal behaviours (e.g. tardiness and absenteeism) [155], job insecurity [42] and intention to quit [89]. It has been shown that some victims of uncivil behaviour will lose work time worrying about future interactions with the offender, some will intentionally decrease their work efforts and some will consider changing jobs to avoid future episodes of incivility. For each eight people who have been victims of workplace incivility, one is likely to leave their job [129].

The stress associated with workplace incivility is seldom left at work, which means

incivility also has repercussions when it comes to the involved parties' health and personal lives. Incivility intensifies the victim's psychological distress [43] and is harmful to their mental and physical health, and general well-being [102]. It then impacts on the marital satisfaction for both the victim and their partner, and family-to-work conflict for the victim's partner [25, 68]. This means that, as people who have been targets of incivility go home feeling more stressed and distracted, their partners are likely to pick up more of the family's responsibilities, and those demands might interfere with the partners' work life [68].

2.3 Affect categorisation

Being a victim of incivility might cause people to experience negative emotions. There are several theories of affect, so in order to better explain the way incivility might affect its victims' emotions and feelings, this section will present some of them. The research on affect is complex and controversial. There is no agreement in the psychological field on a universal classification of emotions or affective states, or even on a set of basic emotions. Affect can be divided into time-related categories that are based on the fact that emotional life has a finite temporal structure. In the narrow sense, emotion is usually short-lived and intense. Mood is an affective state that is underlying and fairly prolonged [44].

Figure 2.2: Prototypical facial expressions of Ekman and Friesen's six basic emotions, respectively anger, fear, disgust, surprise, happiness and sadness.

A discrete categorisation of affect was proposed by Ekman and Friesen [55, 62]. Their cross-cultural studies indicate humans display and recognise six basic emotions in facial expressions, regardless of culture. These basic emotions are happiness, sadness, fear, disgust, surprise and anger [54]. Figure 2.2 shows a representation of the posed displays of these basic emotions.

A number of later studies propose the expression of contempt, as pictured in figure 2.3, is also judged correctly by different cultures around the world [16, 58, 61, 108, 168]. However, contempt is not a basic emotion, as it is composed of two basic emotions: disgust and anger.

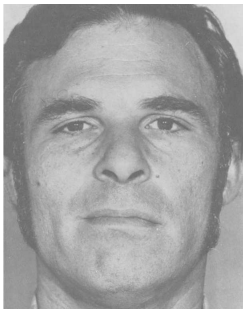

Figure 2.3: Example of the contempt expression - unilateral lip raise and tighten.

Some psychologists make a distinction between primary and secondary emotions [44]. A classification based on primary/secondary affective states was defined by Plutchik in 1980 [135]. He defined a circumplex conic model where the vertical dimension represents intensity of affect and each circular layer represents degrees of similarity between affective states (Figure 2.4). Also, each circle has eight sectors that are organised as four pairs of opposite affective states (e.g., ecstasy is opposite to grief in the bottom circular layer). In this classification there are eight primary affective states that are composed of the Ekman's six basic emotions (sadness, disgust, anger, happiness, fear and surprise), plus anticipation and acceptance. The remaining (secondary) affective states are produced by combining primary affective states that are adjacent on the emotion wheel and are analogous in colour [135].

An alternative description for affect is proposed by Russell [144]. He defines a multidimensional emotional space where a horizontal axis and a vertical axis define positive and negative values of valence and arousal, respectively (Figure 2.5) [144]. Core affect is defined as the most elementary consciously accessible affective feeling that need not be

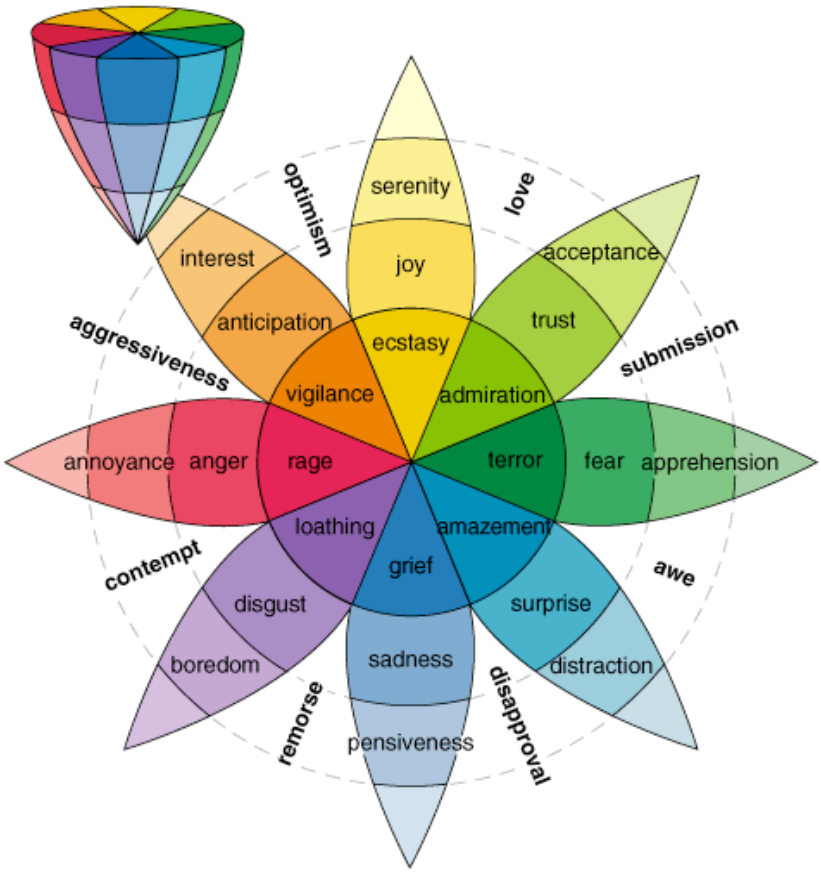

Figure 2.4: Plutchik's circumplex conic model. Image from Wikimedia Commons retrieved in June 2010.

directed at anything [145]. Each core affect falls within one of the quadrants defined by these two axes. This classification is simple and capable of capturing a wide range of emotions and shades of emotions [44].

The four distinct quadrants represent combinations of activation/deactivation and positive/negative affective states. Valence ranges from unpleasant to pleasant affective states. Arousal defines a level of emotional activation that ranges from low (i.e. fatigue) to high (i.e. alertness). The activation level is defined as the strength of the person's disposition to take some action rather than none [44]. Happiness, for example, falls into the positive/active quadrant, while sadness falls into the negative/inactive quadrant.

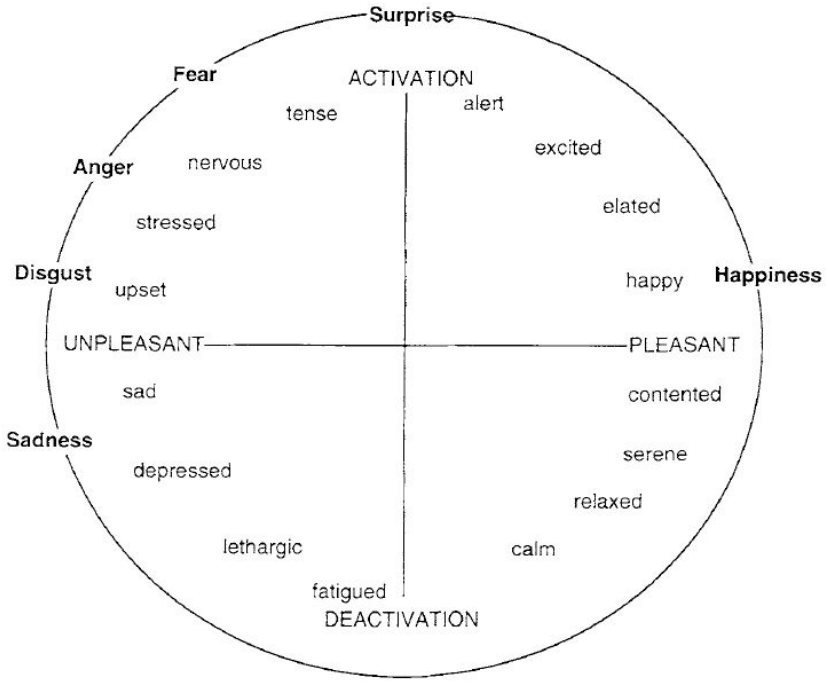

Figure 2.5: Russell's circumplex model of core affect, showing where the Ekman and Friesen's six basic emotions would fall in this classification (image taken from [145]).

An approach that adds one dimension to the previously described model is the Pleasure-Arousal-Dominance (PAD) emotional state model, proposed by Mehrabian and Russell [146]. This model uses three scales to label an affective state or feeling.

The pleasure-displeasure state is defined as positive versus negative affective states. The arousal-nonarousal state relate to the level or mental alertness and physical activity. Finally the last state is the dominance-submissiveness one, which is defined as the feeling of control and influence over the surroundings versus the feeling of being controlled or influenced by situations or other people, e.g. anger and relaxation versus fear and infatuation [114].

To exemplify how emotions/temperament fall in this emotional space, it is useful to dichotomise the three axes in: +P (pleasant) / -P (unpleasant), +A (arousable) / -A (unarousable), +D (dominant) / -D (submissive). The following can be used to describe the resultant octants of the emotional space [113]:

- Exuberant (+P+A+D) vs. Bored (-P-A-D)
- Dependent (+P+A-D) vs. Disdainful (-P-A+D)

- Relaxed (+P-A+D) vs. Anxious (-P+A-D)
- Docile (+P-A-D) vs. Hostile (-P+A+D)

2.4 The effect of affect on human interactions

It has been argued that social and emotional intelligences are the parts of human intelligence that most influence aspects of success in life, especially in social interactions, learning, and adapting to what is important [124]. Affect plays a critical role in cognitive processes in humans, such as focus and attention [48], organisation of memory and perception [23], motivation and performance [35], planning [99], learning [50], goals generation, evaluation and decision-making [46], and communication [18, 55]. Therefore to study an office environment we should leverage the emotions of each of the individuals that are part of the workplace with technology, to improve the interaction.

Besides the psychological and neurological documentation suggesting the influence of emotions in human interactions, there is evidence to justify that more specifically, emotions influence human interaction with computers. It has been shown that providing positive affective interventions to people who are having difficulties solving a problem with a computer, increases their performance [125]. This conclusion was gathered in an experiment that studied the psycho-physiological effects of positive and negative affective interventions in human-computer interactions. Subjects were exposed to pre-programmed mouse delays, while trying to solve an interactive puzzle. After that, positive or negative interventions were provided via a speech synthesiser and the subjects' responses were recorded and analysed. Another experiment was conducted by Kapoor et al. with the aim of assessing user frustration. A set of children were asked to solve a computer version of the Towers of Hanoi puzzle. The subjects' non-verbal multi-modal data was analysed, with the objective of trying to predict when the children were feeling frustrated [90]. Branco et al. observed the spontaneous facial expressions subjects portray while trying to format a document in Microsoft Word, with the objective of identifying adverse event occurrences in the user interface [27]. It has also been proven that while working with computers, people display emotions that are caused by the interaction with the computer. [149]. To assess this, an experiment where some people were continuously recorded while working in their every tasks with the computer, was conducted. Sequences where people were showing emotions that were caused by the interaction with the computer were extracted. Some of

these video sequences were presented to 75 people on an online questionnaire, who clearly agreed in the labelling of affective states such as frustration, fatigue and concentration.

2.5 Apology and forgiveness

One way to restore an office environment's homoeostatic equilibrium, by promoting positive affect following an episode of incivility, would be to provide mechanisms for apology and forgiveness.

2.5.1 Apology

An apology is "an oral or written expression of regret or contrition for a fault or failing" [2]. Receiving an apology from an offender has been shown to encourage forgiving [47, 65, 169], especially when apologies are elaborate and profess an admission of guilt [47, 169]. Expressing an apology might lead to the perception that the offender is feeling guilt and emotional distress due to their awareness of how their actions have been hurtful and harmed their target [12].

2.5.2 Forgiveness in human interactions

Forgiveness is a pro-social motivational change in someone who has incurred a transgression [110]. It implies giving up resentment and desire to punish someone. When people forgive, they become motivated to engage in relationship-constructive, rather than relationship-destructive, actions towards the offender [112]. Forgiveness is influenced by psychological processes such as empathy for the transgressor, attributions and appraisals, and rumination about the transgression [110].

The victim's empathy for the transgressor is strongly correlated with the extent to which they will forgive the transgressor for a particular offence. When an offender apologises for their actions, they express a degree of fallibility and vulnerability, which might increase the empathy the victim feels for them, therefore increasing their motivation to forgive the offender [110].

Generous attributions and appraisals of the offender and the transgression are other of the factors that might motivate the victim to forgive an offence. If the offender is more likeable [26] and the explanations they present for the offence are more adequate and honest [153], the victim is more likely to forgive them.

Finally the more the victim ruminates about a transgression, the higher are their levels of revenge and avoidance motivation, which hinders forgiveness [111].

Forgiveness can be influenced by five factors [110, 111, 112]:

- The severity of the offence,
- the frequency and severity of previous offences,
- the offender's intent,
- the offender's apology and efforts to repair their action,
- previous interactions with the offender, during which they have demonstrated benevolence.

There are numerous reasons for trying to resolve disrupted interactions through forgiveness [162]. It mediates and settles disputes, to sustain healthy long-term relationships [112]. It can increase the perceived debt of the transgressor to the victim [91]. Forgiveness is an emotion-focused coping strategy that can reduce stressful reactions to transgressions, thus lowering health risks and promoting health resilience [171]. And a forgiving attitude, rather than a vengeful outlook, promotes cooperation [7].

2.5.3 Forgiveness in computer-mediated communications

Reputation is the set of beliefs that are held about someone or something. Online auction and market companies, such as eBay, rely on reputations, fed by feedback mechanisms from transactions, to establish trust between buyers and sellers, foster trustworthy behaviour and discourage unskilled or dishonest people from participating [139]. In these environments trust can be broken when some part of a transaction goes wrong, e.g. a product is faulty, the delivery is late or the communication isn't good. A reputation system "collects, distributes, and aggregates feedback about participants' past behaviour" [139]. There is a high correlation between buyer and seller feedback on eBay, which suggests they reciprocate and retaliate when giving reputation ratings [96, 140].

On eBay, when an auction ends and an item is sold, both seller and buyer receive notifications from the site, advising them to contact each other and arrange for delivery and payment of the item. Once the transaction is completed, eBay actively encourages both parties to provide feedback for each other, about this transaction. This feedback can

be positive, negative or neutral and a textual comment can also be added. eBay calculates a feedback score based on these ratings, generally adding 1 point for positive feedback and subtracting 1 point for negative feedback. This feedback score is the most important indicator of a person's reputation on eBay, and is visible to all eBay members. And, logically, a seller with better reputation is more likely to be trusted by potential buyers.

These reputation systems have, however, taken little provision to encourage the repair of trust breakdowns. A first attempt of doing so was made by eBay in their "mutual feedback withdrawal" feature, where sellers can retrospectively contest negative or neutral feedback they've received, provided both buyer and seller agree to do so. By doing this the buyer can go back on their initial rating of the seller, and improve their reputation score. This way, eBay is providing the seller with an opportunity to apologise, explain their intentions, and repair the action, which might lead to a restoration of trust between parties [162].

Forgiveness in Computer-Mediated Communications (CMC) has been widely studied by Vasasou et al. They have proposed to facilitate resolution of trust breakdowns in CMC by integrating an intelligent forgiveness component into online reputation systems [163, 167]. In their conceptualisation, after a breakdown in trust, the system will evaluate the offender's trustworthiness. Only if they are judged positively, will the victim be presented with the mitigating factors that have led to that judgement. The victim can then consider these factors before judging the transaction and giving a reputation score to the offender. This forgiveness component's fuzzy inference system is presented in Figure 2.6.

At a later study [162], they have investigated which of three systems repairs a trust breakdown, by encouraging the victim to forgive and trust an unintentional and infrequent offender. These systems were: A reputation system, that presented the offender's previous good standing with other members; an apology channel, that showed the offender's apology; and a forgiveness component, integrated into the apology channel. They concluded the reputation system alone could not alleviate online offences, and the apology channel could not repair the trust breakdown, but when combined with the forgiveness component, it could. When the offender was given the opportunity to repair the action, the victim's trust could be restored.

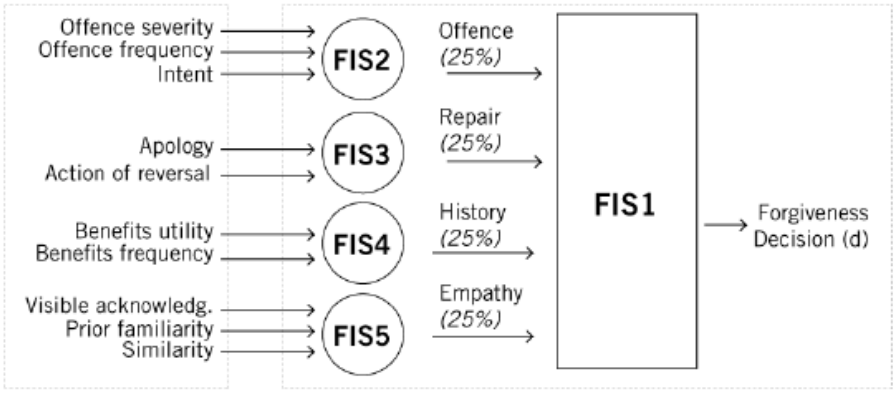

Figure 2.6: Forgiveness decision maker proposed by Vasalou et al. (image taken from [164]).

Figure 2.6 shows Vasalou's forgiveness decision maker, which is built with 5 fuzzy inference systems (FIS). Ten signals of forgiveness are computed in groups regarding:

- Offence, composed of offence severity and frequency and the offender's intent to cause harm.
- Repair, composed of both the apology and the action of reversal.
- History, composed of the benefits history between parties, with signals of benefits frequency and utility being used.
- Empathy, composed of visible acknowledgement of the offence by the offender and prior familiarity and similarity between parties.

After these 4 FIS are computed, they are used to calculate the final FIS, which results in the final decision. The 4 factors have an equal weight of 25% because the author isn't an expert in the field of psychology, and therefore did not know how each motivating factor weighs in the overall forgiveness decision.

2.6 Interpersonal connectedness

Another factor that might contribute to positive affect is interpersonal connectedness. The need for positive social relationships is one of the basic and universal human needs [106, 151]. Humans are driven by nature to establishing and sustaining belongingness [11].

People belong to a number of social networks (e.g. family, friends, work). Interpersonal connectedness is defined as the sense of belonging, based on the personal appraisal of having enough social contacts [11, 161].

People's social networks have the tendency to be stable, which should lead to a relative stable sense of connectedness [161]. Nevertheless this sense of connectedness can change, as it might be influenced by the assessment of current events that are relevant for experiencing belongingness [106, 161]. This means that a temporary social interaction can influence the feeling of interactional connectedness and can endure for a while.

Changes in emotions (both positive and negative) are related to belongingness. Being accepted or welcomed increases the feeling of belongingness and leads to positive affect, while being rejected or ignored decreases the same feeling and leads to negative affect [11].

Van Bel at al. [161] have defined a set of characteristics that a measure of interpersonal connectedness should have:

- The measure should capture the affective experience of belonging,
- it should be based on measurements of one's network, the number of interactions and the closeness of bonds,
- it should include one's total social network, while being sensitive enough to pick up changes in interpersonal connectedness induced by events involving specific individuals,
- and it should be sensitive to changes over time, and able to capture both momentary connectedness and interpersonal connectedness that extends over a large time span.

2.7 Quality of experience in the workplace

By addressing the problem of workplace incivility, by means of providing ways for people to be aware of their actions, being able to apologise for them, and for other people to forgive them, we're trying to promote the re-establishment of the homoeostatic equilibrium, which will have a positive impact in the quality of experience in the workplace.

Quality of Experience (QoE) is a subjective measure of a person's experience with a service or product, in a particular context [97]. It links subjective human factors – such

as the person's perception, experience and expectations, with objective human cognitive factors, which predict human performance [98].

Most people spend a large amount of their waking hours in the workplace, so the workplace is one of the most defining aspects of their lives. That's where people make friends and feel the most creative and innovative, but also where people can feel frustrated and taken for granted [71]. QoE in the workplace is a measure of people's satisfaction with factors such as ergonomics, environment and relationship with co-workers and bosses.

As innovation becomes more and more ingrained in everyday life, the ability to "combine and connect know-how, competencies and networks will be key" [71]. The workplace will be increasingly shifted towards cooperative work and connectivity among co-workers, which will be fundamental for achieving work's goals and satisfaction.

Part of a good QoE in the workplace is related to individual expertise and team success, i.e., the feeling of being a valuable part of a successful team. The factors that contribute to that are collaboration, fun, stability and structure, opportunity to gain competence, and opportunity to leverage personal strengths [66].

Different companies have different strategies to promote employee engagement, connection and general satisfaction with the workplace. Examples are those of Whole Foods Market's signature experience, team-based hiring, in which employees from each department of every store vote on whether a new hire stays or goes after a four-week trial period [66]; Nokia, who have created an internal social network to foster communication between employees who need to work collaboratively [72]; and Google, who have fun and functional offices that are designed to encourage interactions between employees [79].

2.8 Summary

Workplace incivility is considered to be a contemporary workplace crisis, and the entry level form of workplace mistreatment. It is a low-intensity form of deviance, with ambiguous intent to harm the victim, and therefore it is not always easy to detect and address. It has, however, serious consequences, when nothing is done to stop it from happening and/or punish the offenders. It might lead to an incivility spiral, where a set of retaliation actions are taken by both offender and victim, where they alternate the roles of offender and victim, and the intensity of the offence increases on each consequent action. It might then escalate into a more serious type of deviance, such as conflict or aggression. Incivility

might also cause work-related disturbances, victims' mental and physical health problems and personal life repercussions.

When people who are uncivil are made aware of their harmful actions, they might experience guilt, which might lead them to apologise for their behaviour. Apologies have been established as promoters of forgiveness, especially when they are elaborate and state an admission of guilt. Forgiveness is a pro-social motivational change in someone who has incurred a transgression. It implies giving up resentment and desire to punish someone. Forgiveness mediates and settles disputes, to sustain healthy long-term relationships, can increase the perceived debt of the transgressor to the victim, and can reduce stressful reactions to transgressions, thus lowering health risks and promoting health resilience. Additionally, a forgiving attitude, rather than a vengeful one, promotes cooperation, which, in current workplaces, is often desirable, if not mandatory. Forgiveness will therefore increase interpersonal connectedness, as being accepted or welcomed increases the feeling of belongingness and leads to positive affect.

The following chapter will present the studies that, along with this chapter's interdisciplinary analysis of incivility, have led to the definition of requirements for a platform to address the problem of workplace incivility.

3

Assessment of uncivil behaviours in real workplaces

3.1 Introduction

Chapter 2 has described the workplace incivility problem and ways in which that problem could be addressed. We've established a route through which we can propose a solution, based on behaviours of apology and forgiveness.

This chapter is focused on finding the incivility behaviours that occur in real workplaces and rating those problems by their level of annoyance and frequency by which they are mentioned.

The first stage of this process was to conduct a set of interviews, asking people who share a workplace, questions about issues that happen in their workplace, their awareness about their own behaviours, and issues that happen in shared spaces outside the office, e.g. kitchen or toilets. Twelve people, all PhD students or researchers were interviewed.

The second and last stage of the process was to create a questionnaire that expanded on the previously asked questions. Added to the questions about others' and self-behaviours, people were also asked about strategies they use to cope with incivility and the existence and enforcement of social norms at their workplace.

3.2 Interviews for preliminary assessment of existing issues in shared workplaces

The initial stage of this project consisted of some interviews and an online questionnaire (expanded on Section 3) aimed at understanding the main issues that cause problems in shared workplaces, and how people prefer to deal with them.

The interviews were conducted to obtain a preliminary overview of what issues might arise when people need to share a workplace. They were conducted in an academic environment, and all respondents are PhD students or Research Associates. All workplaces have different characteristics and different people, which makes them different from each other. Whereas in most types of jobs, people might be working in the same room as their bosses, typically that does not happen in the academic environment. Also, PhD students and Researchers often need to read and write papers and reports, which makes silence more important in these sorts of environments than it is expected to be in other sorts of work environment, e.g. a design company or a software house.

We were interested in finding out what types of behaviours people consider annoying or off-putting, while having to share a workplace. Three types of behaviours were covered: behaviours from people in the workplace, awareness about self-behaviours, and behaviours from people in the shared areas of the workplace (such as the lifts, kitchen, etc.).

Besides some basic demographic questions, twelve people were asked the following four questions:

- Are there behaviours of others in your workplace that you find annoying or off-putting?
- From the behaviours you mentioned before, is there one you find more annoying than the others? If so, which one?
- Are there behaviours of yours in your workplace that others might find annoying or off-putting?
- Are there behaviours of others in the shared areas of your workplace (e.g. kitchen, lifts, etc.) that you find annoying or off-putting?

Although having interviewed a relatively small sample of people, we could gather some conclusions from the analysis of the replies.

From the analysis of the first question, the most important finding is that every single person indicated noise as a distracting and annoying problem. This noise can be originated from different sources: people talking, music coming from headphones and phones ringing. About half of the respondents mentioned smelly food being eaten in the workplace as another source of problems.

Privacy was a main concern for five people. They referred the lack of privacy some office layouts create, where other people can look directly into their screens, or their faces.

Three people mentioned people moving inside the workplace, or people going in and out of the workplace, were a source of distraction.

Another important finding from the analysis of this question is that, for some people, the context is very important when it comes to whether some action annoys them or not. For instance, if people are trying to read, the noise is further more distracting than when they are performing a task that requires less concentration.

When asked to indicate the one thing that annoyed them the most, two people couldn't single out one option. From the remaining ten people, eight pointed out noise-related issues as the most annoying actions in a shared workplace.

Question 3 had the objective of trying to assess how self-aware people are. Ten out of twelve people said they believed they did something that could potentially annoy other people. From these ten people, nine indicated noise-related actions they might be guilty of doing in their shared workplaces.

The interviews served as a first insight into the workplace incivility problem, and were very valuable for the amount of qualitative answers we got. It was very clear noise was the main issue when it comes to academic environments. As far as self-awareness is concerned, people had to think about their actions before answering whether or not they did something that might be annoying for their co-workers. But in hindsight, most of the people thought they were guilty of occasional potentially annoying acts.

3.3 Survey for assessment of uncivil behaviours in workplaces

The survey consisted of an online questionnaire that was built with the purpose of understanding questions related to disruptive behaviours in shared workplaces. In spite of that

being the main objective of the questionnaire, it was also necessary to gather some information about the respondents' demographic data and working environments. Therefore the questionnaire was divided into five sections:

- Demographic data: Personal characterisation of the respondents when it comes to age, location, gender and level of education, among others.
- Job description: Asking for a short description of job functions, if the person has a leadership position and the amount of individual v. collaborative work they have to perform.
- Workplace description: Workplace demographic data, such as gender, age and number of people who share the same room.
- Behaviours: Questions about others' and self-behaviours that are considered to be annoying, in the context of shared workplaces.
- Norms/rules: Questions related to official and mutually-agreed on norms/rules for the workplace.

Most of the questions in the Behaviours and Norms/Rules sections were open-ended. We decided to allow respondents to write freely about their experiences, rather than providing them with options and ask for their opinions about them. On the one hand we did not want to influence their replies; on the other hand if we had used closed-questions we might have left out situations that might happen but hadn't occurred to us. The full questionnaire can be found on Appendix A.

The questionnaire was advertised in several mailing-lists and social networks and was published online in order to reach a broader range of respondents, when it comes to countries of nationality and residence/work, and age. Although more people replied the questionnaire, only full responses were considered for this analysis. Also only people who share or have shared a workplace were considered, as we were interested in gathering opinions from people who have real experience in sharing workplaces.

125 people, of which 37 females and 88 males fully completed the questionnaire. They were aged between 22 and 47 years old, with 53.6% of people being under 30 years old, and 5.6% over 40 years old. Most of the respondents are from and work in Europe. Only 14.4% of the respondents are from non-European countries and even less (2.4%) work in non-European countries.

3.3.1 Co-workers' behaviours

The analysis of the *Behaviours* section of the questionnaire shows that noise is a major concern for people who have to share a workplace. The first question of this section asks "Are there behaviours of others in your workplace that you do/would find annoying or off-putting?" and provides six free text input lines. It asks respondents to write their answers in order of importance, i.e., to list the most irritating behaviour first.

Figure 3.1 shows the distribution of answers to the this question, but exclusively for the first of the six inputs, as we were interested in finding out what people consider to be the most annoying behaviour, by a co-worker, in the workplace.

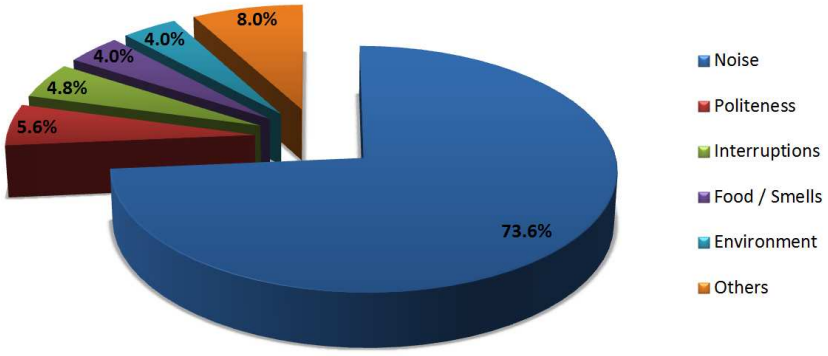

Figure 3.1: Analysis of the first input (of 6) for the question about co-workers' behaviours: Most annoying behaviours, as answered by the questionnaire respondents.

As shown in Figure 3.1, 73.6% of the respondents indicated a noise-related issue, (i.e., "talking loudly", or "phones ringing") as being the most irritating behaviour from a co-worker. These 73.6% represent 92 people.

Breaking down the 92 replies that indicated a noise-related issue as the most annoying behaviour from a co-worker, although 21 respondents replied a generic "noise", the remaining 71 people were more specific. The responses point to the idea that sounds originated by people, either by talking loudly or by having discussions in the shared workplace, seem to be more disruptive than mobile phones ringing, or music being heard from other people's headphones.

Further analysis of this open-ended question, this turn with an analysis of all six inputs, revealed 92% of the respondents indicated noise-related actions as one of the behaviours they do or would find annoying if done by their co-workers. This makes "noise" the far most cited issue, meaning only 10 out of the 125 respondents did not indicate "noise" as an annoying behaviour at all. Interestingly, 6 out of those 10 people are women, which represents 16.2% of the total number of women, while only 4.5% of the 88 men did not mention noise at all.

As each person could indicate up to 6 behaviours and multiple behaviours could be of the same category (i.e. "mobile phones ringing", "people chatting to each other in the room" are both "noise" issues), we counted multiple mentions of the same category by the same person as 1 entry. By doing go, we were able to find out how many people indicated each of the behaviours.

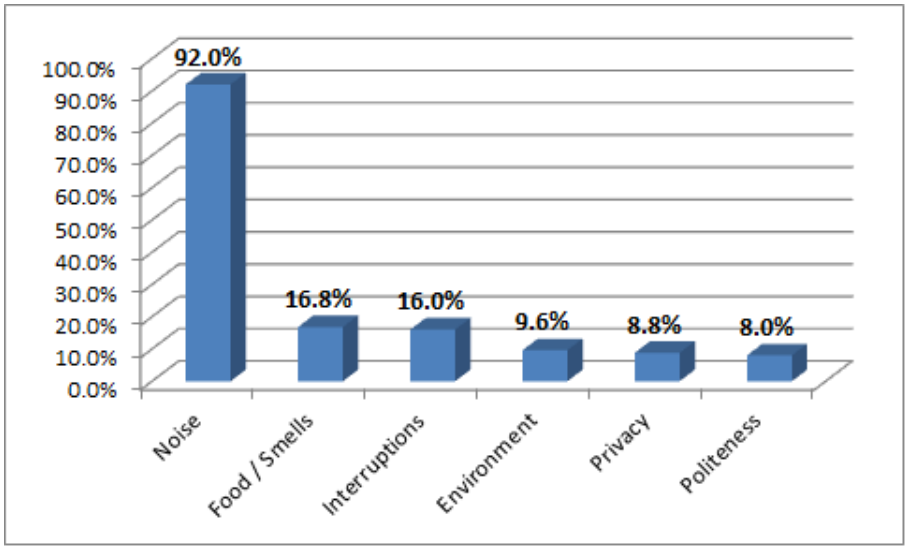

Figure 3.2: Overall analysis of the *behaviours* question by person, with "noise" being the far-most cited issue.

The other situations that were referred a considerable amount of times were issues related to Food/Smells, Interruptions, using the workplace as a Personal space, Politeness, Privacy, Environment and Mess. Figure 3.2 shows the graph of the overall distribution of answers by behaviours, when all 6 inputs are considered. Smells from food or low personal hygiene were mentioned as being an annoying behaviour by 16.8% of the respondents. This was the second most mentioned issue, directly followed by Interruptions (16%). Not

every respondent has filled in all six input fields on this question, which means the overall analysis was made by person / behaviour, rather than, by behaviours.

The absolute amount of times each type of behaviour was mentioned by the respondents was also analysed and is presented in Figure 3.3. Rather than calculating how many people mentioned each of the behaviours, we analysed how many times each of the behaviours was mentioned. Once again, "noise" is the dominant behaviour, with almost 60% of the mentions.

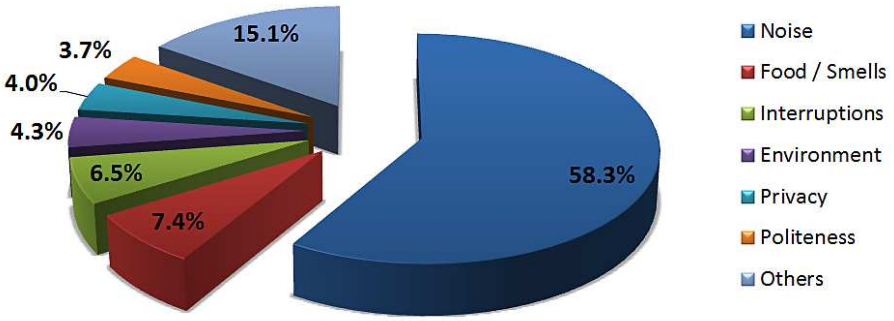

Figure 3.3: Cumulative answers to the *behaviours* question, with "noise", once again, being the far-most cited issue.

3.3.2 Strategies to avoid being affected by uncivil behaviours

The respondents were asked to list the strategies they might use to avoid being affected by the behaviours they'd previously listed as being annoying or off-putting. The question was "Do you use any strategies to avoid being affected by the behaviours you listed above?" and it aimed at learning what people do when incivility happens. As noise-causing behaviours were the most cited issues, we analysed the strategies people use to avoid being upset by that problem.

Figure 3.4 shows the pie graph of the distribution of strategies. The two detached slices of the pie graph represent talking to either the person with the uncivil behaviour (8.7%), or the manager (2.2%). These make for the 10.9% of people who try to solve the problem externally, by making other people aware of it. The remaining 89.1% of people, however, choose not to confront the person or people making noise, and instead use headphones (as

indicated by 64.1% of the people), do nothing (10.9%), work from home (WFH), leave the room or change location / desk (6.5%) or try to ignore it (5.5%).

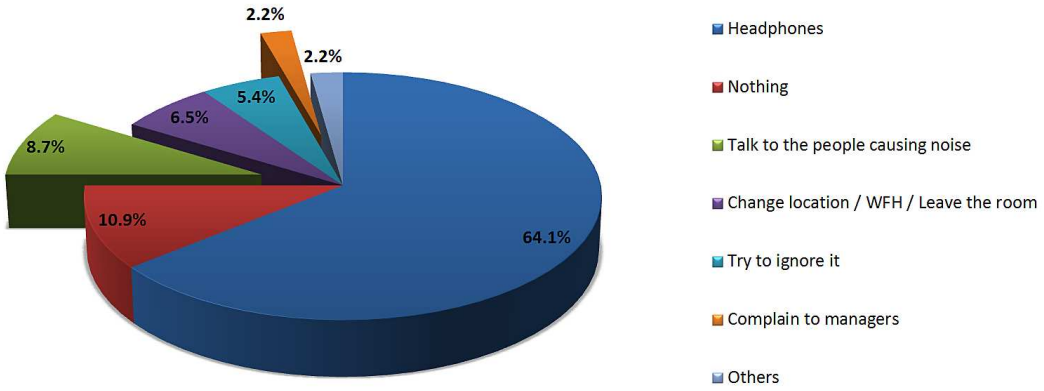

Figure 3.4: Strategies used to avoid being upset by noise-causing behaviours: only 8.7% of the people confront the person making noise and only 2.2% complain to managers about it; the remaining 89.1% change their own behaviours to avoid being affected.

This strategy distribution reflects what the studies on incivility described in section 2.2: Most people are affected by incivility, but not knowing how to solve the problem, they try to find ways to overcome it. But most of the strategies they use do nothing to stop the problem, or make the person who breaks the norms aware of their actions.

Some of the specific approaches pointed out by respondents show how these strategies not only do not solve the problem, as they also cause some disruption to the normal workflow. Examples are:

- A respondent said their strategy is "Listening to music. This also distracts me, but since I'm being distracted anyway, I may as well enjoy myself!".
- Someone said they "Try to get used to it and feel miserable".
- Another respondent said they try to check the noisy people's calendar and work from home when those people are in the office.

3.3.3 Self-awareness

Another of the *Behaviours* section questions regards self-awareness. We were interested in finding out how aware people are of their own behaviours, that might be annoying to their co-workers. The questionnaire asked "Are there behaviours of yours in your workplace that others might find annoying or off-putting?". Like what happened with the question about others' behaviours, respondents were asked to list their behaviours by order of most to least irritating.

82 people, which represent 65.6% of the respondents, presented at least one self-behaviour they think might be annoying to their co-workers. Figure 3.5 displays the distribution of answers by type of behaviour. 34.4 % of the respondents didn't consider they do anything that upsets or is annoying to their co-workers. Almost 2/3 of the people, however, seem to be aware of their actions. Of the 82 people who indicated some sort of self-behaviour, 65.9% said they occasionally had behaviours that caused some sort of noise – by, e.g., talking to other people or having their mobile phones ringing.

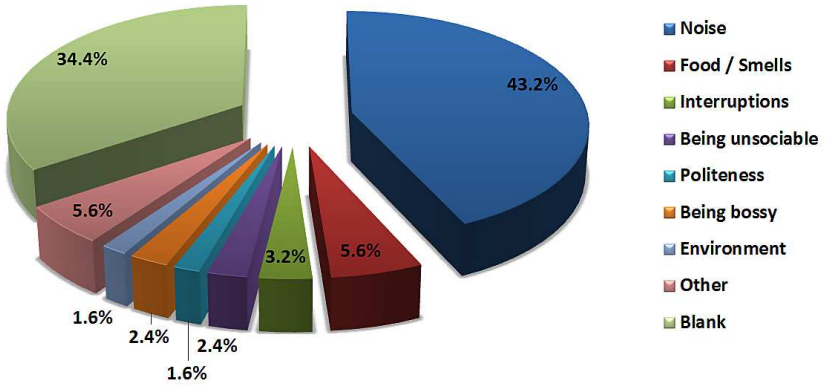

Figure 3.5: Self-awareness results for all 125 respondents - 34.4% of the people didn't indicate any annoying self-behaviour and 43.2% of the people consider they might cause some sort of noise in the workplace.

Even though most people consider noise to be a disruptive, distracting or annoying factor, almost half of the people are still aware that sometimes they are the ones causing noise to happen.

3.3.4 Social norms in workplaces

The last part of the questionnaire regards social norms in force in shared workplaces. The respondents were asked:

- Whether or not there are social norms in the workplaces they work on, either officially imposed by the company, or mutually agreed on between co-workers,
- when norms exist, how they are expressed in the workplace,
- if norms exist, to list some examples of norms,
- if norms exist, what happens when someone breaks the norms.

Only 24% of the respondents replied "Yes" to the question "Are there official norms/rules in your workplace?". This percentage increases considerably when regarding mutually agreed on (possibly tacit) norms/rules, with 55.2% of the people replying "Yes".

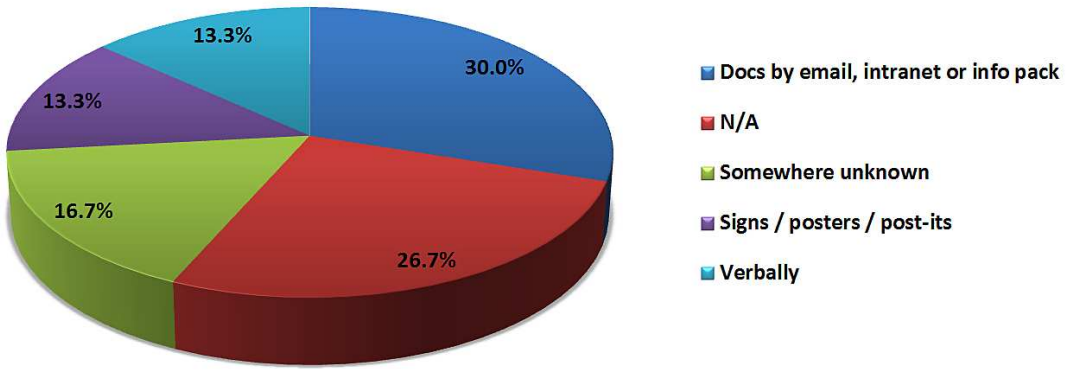

Figure 3.6: Ways in which official norms are expressed in the workplace. This represents a small amount of people (30), as the remaining 95 people don't have any stated social norms in their workplaces.

Figure 3.6 shows the distribution of answers to the question "If there are official norms/rules, how are they expressed in your workplace?". Since only 30 people had said there are official norms in their workplace, this graph represents the answers from those 30 people. 43.4% of those people know there are norms, but they either said norms

aren't available anywhere to be consulted, or that they don't know where they are stated. 43.3% of the places have norms available either in documents in the intranet, or sent by email, or by signs or posters spread around the workplace. Finally 13.3% of the people said they have been verbally informed about the social norms.

It is plain to see that only a small amount of workplaces have stated social norms for their employees, and even a smaller amount of workplaces make it easy for people to be aware of the norms they must abide by.

The 30 people who said there were official norms in their workplace were asked what happens when an official norm is broken. 30% of them said nothing is done when a norm is broken and 16.7% said they don't know what happens. Only 46.7% of the respondents said there was some kind of visible reaction to a violation of norms, either by an email being sent to the whole team, reminding them of the norms, by the person that broke the norms being told off by their superior, or by warnings being sent to the person who has broken the norms. Analysing the whole set of people who have answered the questionnaire, only 11.2% work in workplaces with stated official norms and know there is a consequence for breaking those norms.

3.4 Summary

In order to investigate workplace interactions, we performed interviews and created a questionnaire to query people who share workplaces about incivility-related issues, such as behaviours from themselves or co-workers and existence and enforcement of social norms in the workplace. The interviews made people think about their own actions in the workplace and, when asked if they did anything that could be potentially annoying for their co-workers, most people said they do. This has led us to believe they are not fully aware of their possibly annoying actions while they are performing them, but in hindsight, people can see that some of the things they do, are potentially harmful for their co-workers experience in the workplace.

The questionnaire reached a wider set of respondents, both in number of people who answered it and demographic range. It also covered a broader set of questions than the interview. Despite the fact the interviewed people were all working in an academic environment and were only a small sample, their answers were in line with the questionnaire's answers.

By analysing the questionnaire's answers we concluded that behaviours that cause noise are, by far, the most disruptive actions in the workplace. By analysing the strategies people use to avoid being affected by noise, we gathered the vast majority of people won't do anything to try to solve the problem, but rather change their own behaviours by, e.g., using headphones, trying to ignore the noise, or working from home. These strategies still have a negative impact in people's work, but not as negative as the effect of incivility.

When it comes to respondents' self-awareness, even though most people consider noise to be a disruptive, distracting or annoying behaviour, almost half of the respondents are still aware that sometimes they are the ones causing noise to happen. But, perhaps because in most workplaces there aren't any stated official norms, and even fewer workplaces have specific consequences for violation of norms, it is easy for people to have behaviours that are clearly upsetting for other people, without being aware of how much disruption they cause, or not caring about the consequences of their behaviours.

The previous chapter's inter-disciplinary analysis of incivility, along with the surveys that have highlighted the real issues in the workplace and have been described in this chapter, have defined the requirements for a platform to address workplace incivility, which has led to the need for:

Affective computing

Affective computing, particularly in its affective interaction perspective, is necessary for implementing theories of affect and forgiveness.

It is also relevant for analysing frequency of incivility episodes, and the respective emotional responses they elicit:

- From its victims, who might feel e.g. upset, annoyed or distracted;
- from the instigator, who might feel embarrassed for having broken the norms and someone having flagged their behaviour;
- on a second round, from the victims, in situations where they've received an apology from the offender.
- and on a second round, from the offender, after having their apology accepted by their co-workers.

Pervasive computing

Pervasive computing is necessary for:

- Automatically detecting abnormal noise in the workplace;
- making sense of detected abnormal noise by analysing it, while mapping it with the current context;
- detecting physiological signals of affective dissonance.

Adaptive computing

According to the questionnaire, when faced with incivility, most people's coping strategy is to disengage. They try to change their own behaviours, or the endure the situation, and very seldom choose to confront the instigator. This means people need to be empowered and this is where adaptive computing has a predominant role, as it allows for a process of definition and adaptation of social norms.

4

Definition of technological requirements

4.1 Introduction

In the previous chapters the literature review and the surveys have identified incivility as an ongoing problem in current workplaces, and specifically noise-related incivilities as the biggest issue. These findings have led to the definition of requirements for a new platform to address incivility that should be grounded on:

- Affective computing, because it would be relevant to integrate theories of affect – allowing for automatic detection of affective dissonance – and forgiveness into a final implementation.
- Pervasive computing, as it would be relevant to have both automatic detection of psycho-physiological signals from people, in order to assess affect, and environment variations, such as noise spikes, to assess violations of norms.
- Adaptive computing, because of the need for participatory definition and adaptation of social norms, by the people who are affected by them.

These are the technological requirements for an ideal solution. Our solution will only make use of adaptive computing but not of affective or pervasive computing, as automatic detections of both affective dissonance and environmental signals are not part of a first version of the solution.

This chapter will expand on adaptive computing as a tool that will be used in developing a platform to address the problem of workplace incivility and affective and pervasive computing as requirements for a future version.

4.2 Affective computing

Affective computing, a relatively recent area in the Human-Computer Interaction (HCI) field, aspires to bridge the gap between emotional humans and emotionally-challenged computers, by building computational systems that recognise affective states and respond to them [29].

More and more systems are being developed in a user-centred fashion, instead of the traditional computer-centred way. Thus, gradually, the burden of adaptation is changing from the user to the machine [80, 103].

Affective computing can be separated into three different perspectives on emotion and design: That of the traditional vision of what "affective computing" is, which emanates from the Artificial Intelligence (AI) field; that of "affective interaction", which takes an approach based on a constructed, culturally-determined perspective on emotion; and that of "technology as experience", in which emotions are seen as part of a wider set of experiences, from which they cannot be singled out [78].

4.2.1 Affective computing

Affective computing has been defined by Rosalind Picard as "computing that relates to, arises from and deliberately influences emotion" [131]. It aspires to bridge the gap between emotional humans and emotionally-challenged computers, by building computational systems that recognise affective states and respond to them [29].

With the growing development of studies and systems on affective computing, computers are increasingly approaching more naturalistic human-human interactions, displaying their own affective states and reacting to users' affective states [39].

Various different sensors are used to collect affective data, some more intrusive than others. Examples of non-intrusive sensors are cameras, that can capture facial expressions, gestures and posture; and microphones, that record background sounds and speech. More intrusive sensors require some sort of physical connection with the person. Examples are neuro-headsets, that claim to capture electric signals produced by the brain to detect user's

thoughts, feelings and expressions in real-time; eye trackers, that measure eye positions and movements; and galvanic skin response (GSR) sensors, that measure the electrical conductance of the skin, which varies with its moisture level, i.e. sweat, and can be an indication of psychological or physical arousal.

Much of the work done on identifying affective states is made on facial expressions. Most of the studies on facial expressions are based on posed expressions of the Ekman and Friesen's six basic emotions [54, 59] (previously described in section 2.3). Posed emotions differ significantly from spontaneous expressions in visual appearance, audio profile and timing [33, 34, 160, 173]. They show a single temporal pattern of an affective state - onset to apex to offset - that begins and ends with a neutral state. However, this rarely happens in real life, since humans often show affective states that include multiple apexes without neutral states in between.

Posed displays of affective states are usually recorded with high quality video and audio, with good lighting conditions, without occlusions (e.g. hands in front of the face), and with clearly perceptible front- or profile-view faces [173]. When it comes to naturalistic settings, it is unlikely that the displays of affective states will be captured in such ideal conditions. Consequently, the study of spontaneous affective states represents a challenge for affective computing, as existing systems, that are typically developed and trained on posed data, have difficulties handling spontaneous expressions of affective states [124].

Ekman and Friesen created the Facial Action Coding System (FACS) in 1978 [56] and revised it in 2002 [60]. FACS is a system that describes "all visually distinguishable facial movements" [56]. It defines Action Units (AUs) - atomic facial signals - that cause different facial movements. AUs are considered to be the smallest visible facial movements and are independent of personal factors, such as e.g. age or gender. Figure 4.1 shows how the expression of the basic emotion "fear" is labelled in FACS.

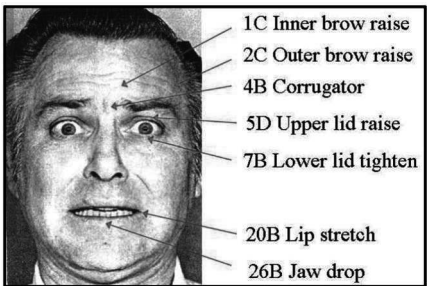

Figure 4.1: FACS coding of AUs for the expression of fear.

Besides the definition of AUs, FACS also provides rules for visual detection of temporal segments of onset, apex and offset for each AU. The onset time is the span between the start of each AU and when it reaches apex; the apex time is the period of maximum excursion; and the offset time is the span between the end of apex and the neutral state [57].

Despite the fact most work on facial expressions has been done on the posed expressions of the six basic emotions, these are arguably not the most common emotions displayed in everyday interactions [45, 63, 143]. For instance, in office-based HCI scenarios, due to the nature of the typically performed tasks, affective states such as confusion, frustration, understanding, fatigue, and satisfaction are expected to occur more frequently than the basic emotions [105, 149]. Additionally, most of the work has been done in non-real-time detection [173], which is restrictive for practical affective computing applications [29].

4.2.2 Affective interaction

If sometimes it is difficult for humans to understand their own emotions, how can computers be expected to consistently, accurately, being able to do so? The affective interaction perspective on affective computing is less concerned about recognising, modelling and representing human emotions, and more interested in using computers to support people in understanding, interpreting and experiencing their own emotions, in their full complexity and ambiguity [20, 78].

Boehner et al. [20] argue viewing emotion as objectively measurable facts, limits and distorts people's understanding of the nature of daily emotional experiences. They believe

the understanding of the nature of emotional experience can he enhanced by turning to cultural, social and interactional accounts of emotion. The interactional approach:

1. Recognises affect as a social and cultural product, where the surrounding context plays a crucial part in construing affect.

2. Relies on and supports interpretive flexibility, by leaving the definition of emotion and its interpretation to users, rather than systems.

3. Avoids trying to formalise emotions, allowing users to supply the emotional meaning, instead.

4. Supports an expanded range of communication acts, rather than just verbal articulation and translation of how someone might be feeling.

5. Focusses on people using systems to experience and understand emotions, i.e., rather than making systems more aware of emotions, it focusses on making people more aware of emotions, through system use and design.

The affective interaction approach is more flexible, in the sense that it attempts to avoid winding down human experience to a set of measurements or assumptions, made by the system, to interpret users' emotional states [78].

4.2.3 Technology as experience

The technology as experience branch takes a holistic approach to understanding emotion, rather than separating emotion processes from everything else [78].

Bill Gaver [69] believes humans express, experience and sometimes mask sets of emotions that are too complex to correctly and effectively be identified by computers. Hence, he advocates a broader view of interaction design, in which "open-ended designs serve as resources for individual appropriation", and suggests that emotional experiences become one of the diverse consequences of engaging with them. These designs should embody understandings of emotion, aesthetics, sociality and culture, and lead to new insights, which means emotion is seen as an important facet of design, but not the only one, and not always the most important one.

The technology as experience approach proposes a new way of seeing experience with technology, "as creative, open, and relational, and as participating in felt experience [109].

4.3 Pervasive computing

The goal of pervasive computing is to create ambient intelligence, where networked devices embedded in the environment provide inconspicuous, uninterrupted and dependable connectivity, while also performing other services. This leads to an improved user experience, without explicit users' awareness of how much technological communication and computing is happening on the background [41].

In 1991 Mark Weiser wrote "the most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" [170]. He argued that only when things disappear in this way, are people free to focus on new goals, other than dealing with technology. 22 years later the physical environment we live in is saturated with computing and communication devices that interact among themselves, as well as users [40]. The current "computing landscape" comprises of a vast number of devices (e.g. smartphones and tablet computers) that constantly collect and store information [41].

Pervasive computing aims at creating digital environments that are sensitive to human needs, and adapt and respond accordingly [147]. In these environments, pervasive applications become ideally invisible, as envisioned by Weiser, which is made possible by their degree of integration and need for minimal human input. For all this to be achievable, systems and devices that are part of the digital environment need to be context-aware and use this context-awareness smartly. Pervasive computing requires systems and devices that perceive context in an accurate way, followed by intelligent control or action between machines and humans [147].

In pervasive computing sensors are installed anywhere, and on any objects or human bodies. These sensors collect data that include user's or objects' location, motion, physiological information, environment temperature, humidity, or ambient noise level [172].

Affect sensors are devices that receive input signals and process them, in order to detect some evidence of affect [156]. Included in these, are skin conductance sensors that detect changes in the electrical resistance of the skin, reflecting the functioning of the sweat glands controlled by the sympathetic nervous system [4], pressure-sensitive mice [141], and sensors to detect an electrocardiogram (ECG) and respiration [28].

Strauss et al. [156] have proposed a small, wireless, networked skin conductance sensor for affective computing applications, HandWave. The sensor is mounted on the wrist with

Velcro straps, with electrodes being placed on the hand. HandWave has successfully been used on an environment designed to support children engaged in enquiry-based science learning activities, for visualisation of user attention maps; along with other sensors, on a learning companion that mimics the user's affective expressions; and on a multi-player biofeedback video game that teaches players how to relax in a competitive environment, while learning to cooperate with a team – where the team that relaxes the most, i.e. whose skin conductivity decreases the most, wins.

Brown et al. [28] have reported on a body area network (BAN) for monitoring the autonomic nervous system responses. This BAN integrates both a chest belt to record ECG, and a wrist sensor to record skin conductance. They have evaluated the system by showing subjects emotionally stimulating short films, and comparing the self-reported emotions and intensity with the signals captured by the BAN. The results suggest, when applied to monitoring autonomic nervous system signals, this system may enable real-time emotion monitoring.

More recently, the Advanced Multi-modal Biometric Emotion Recognition (A.M.B.E.R.) project has been developed to create a low-cost, unobtrusive, physiology sensitive system, which incorporates a minimal set of physiological sensors [30]. They've created a biometric mouse, the AMBER Shark-fin Mouse, which can output three physiological signals in real time, while being used as a fully functional mouse. The three physiological signals are: Heart rate, skin conductance response and body temperature. This mouse, though still being a prototype, hence requiring further refinement, produces clean and reliable signals in real time, while not using intrusive sensors.

Environment sensors can collect data related to e.g. noise levels and temperature, which make them very relevant for this thesis, as on the questionnaire survey explained on Chapter 2, most people have indicated noise is the most annoying issue, while sharing a workplace.

Audio sensors are increasingly being used in surveillance and monitoring applications [6]. These sensors can distinguish background ambient noise from louder noise and spikes in volume. Several different settings have been used before, ranging from using a single microphone as a single input for surveillance data [6], and for finding "interesting" events in an office environment [74], to using 85 microphones, along with 8 cameras, to support a group of students on a lab assignment related problem [118].

On [6] it was possible to capture audio input from a single microphone and distinguish the sounds between vocal and non-vocal audio, and within those categories, to distinguish between talking and shouting, and between walking, running and door knocking.

An experiment has been done in an office environment, also with a single microphone, recording everything but background noise [74]. In this experiment they've managed to record and distinguish sounds from people typing on the computer keyboard, phones ringing and people speaking.

The use of several microphones can add information to the recorded audio signal, as those microphones can collaboratively detect, locate and classify different sounds, and determine the approximate location and type of sound [174]. In [152] six microphones have been used to calculate "audio location", a technique for accurate location sensing, using off-the-shelf audio hardware.

It would be interesting to find ways to automatically identify situations where people might be causing instability in their workplace, by either being noisy, or causing noise to happen, by leaving their phones to ring in the workplace. The solutions that provide sound detection and location would be the most relevant, as not only would they indicate the occurrence of the abnormal sound, as they would also point to its origin. In order to use such systems, a standard coordinate frame of reference for the room map would be required, so the origin of noise could be located.

The current version of our solution does not include automatic detection of psycho-physiological signals or environment variations, so this section is a definition of what would be desirable in a future version, rather than a description of what has been used to develop our solution.

4.4 Adaptive computing

Adaptive systems are embedded systems that change their structure or behaviour over time in response to changes in the environment. Examples can be found in:

- Autonomic computing, the self-managing characteristics of distributed computing resources that are able to adapt to changes in the computing environment, business policies and objectives [38]. Such systems' self-management properties comprise self-configuration, self-optimisation, self-healing and self-protection [81, 92].

- Complex systems, made by a large number of highly interconnected dynamical units [8, 19], that need to interact and form relationships with the environment they are inserted in.

- Stigmergy, a mechanism of indirect coordination between agents or actions that follows the principle that the trace left in the environment by an action stimulates the performance of a next action, by the same or a different agent. It implements self-organisation and produces intricate, apparently intelligent structures without need for planning, control or direct communication between agents [107]. Stigmergy has been applied to various areas of computing, namely robotics [138], multi-agent systems [73, 159] and communication networks [49].

- Swarm robotics, the application of swarm intelligence [13, 21] to collective robotics [53]. Swarm robotics systems are characterised by decentralised control, limited communication between robots, use of local information and emergence of global behaviour [52], and cooperate to solve problems that go beyond the capacity of each individual [53].

In this thesis, we are interested in adaptive systems whose environment explicitly includes a set of conventional (mutually agreed) rules, and in the behaviour of system components that seek to comply with or modify that set of rules. An overview of approaches to such systems can be found in [132].

The specific work we will build on is the approach based in self-organising electronic institutions [133, 134], itself rooted on a computational logic formalisation of Elinor Ostrom's institutional design principles [122] as a set of conventional rules. Ostrom [122] argues that the management of common pool resources (CPR) does not have to be centralised, and instead, there could be a self-management of CPR. Therefore, she has proposed eight socio-economic design principles for self-governed enduring institutions:

1. Clearly defined boundaries: Effectively excluding un-entitled parties.

2. Congruence between appropriation and provision rules and local conditions.

3. Collective-choice arrangements: "Individuals affected by the operational rules can participate in modifying the operational rules" [122].

4. Effective monitoring by monitors who are part of or accountable to the appropriators.

5. Graduated sanctions for resource appropriators who violate communal rules.

6. Mechanisms for conflict resolution that are cheap and of easy access.

7. Self-determination of the community recognised by higher-level authorities.

8. Nested enterprises, from the lowest level, up to the entire interconnected system.

Pitt et al. [133] have formalised six of Ostrom's eight design principles (principles 1 to 6), by creating an axiomatisation of those principles in computational logic.

They propose and prove open, embedded and resource-constrained systems can be considered from Ostrom's standpoint of institutions for management of CPR. These systems have decentralised control, competition for resources and expectation of intentional and unintentional errors. In these systems "robustness" and "survivability" of the distribution of resources mechanism, based on collective decision-making, and tolerance of unintentional errors, are more important than an optimal distribution of resources.

They also propose and show Ostrom's principles can be considered from the perspective of agent norm-governed systems, and can be axiomatised in computational logic.

This thesis problem is incivility in the workplace. A workplace is composed of several people who need to share a physical space, machines and resources. This can be seen as an open, embedded, resource-constrained system, as such systems consist of "heterogeneous components of unknown provenance that are coordinating their behaviour in the context of an environment which may be perturbed by outside events" [133].

Therefore, instead of using agents, we would use people in a socio-technical system founded on Pitt et al.'s [133] axiomasation of the Ostrom's principles, where the system provides the decision-support, and the people do the decision-making.

This decision-making is related to a definition and adaptation of social norms over time, but also to attempting to solve incivility, by allowing people to do the monitoring of each other's compliance with the norms, and by that, providing conflict-resolution mechanisms that don't require external intervention.

4.5 Summary

Despite being a relatively young area in the HCI field, affective computing has branched out to a few different approaches, each of them with valuable contributions to various fields, such as e.g. learning, health-care and affective communication.

The most traditional affective computing branch tries to recognise, model and represent human emotions, and use them for further interaction from/with the computer. Affective interaction is more interested in using computers to support people in understanding, interpreting and experiencing their own emotions, in their full complexity and ambiguity [20, 78]. So rather than trying to infer which emotion someone might be experiencing, affective interaction might present the user with tools that will assist them in analysing and labelling their own emotions. Finally, technology as experience represents a shift of focus from emotion as an isolated phenomenon, towards viewing emotion processes as one of the aspects to consider when designing tools for people [78].

Pervasive computing aims at creating digital environments that are sensitive to human needs, and adapt and respond accordingly [147]. Several different sensors capture different signals, that could be used for a solution to address the problem of workplace incivility, namely physiological sensors that measure and record skin conductance, heart rate and body temperature, and audio sensors, that could identify and locate sources of abnormal noise in the workplace.

Adaptive systems are embedded systems that change their structure or behaviour over time in response to changes in the environment. Examples can be found in autonomic computing [38, 81, 92], complex systems [8, 19], stigmergy [107], and swarm robotics [13, 21, 53]. All of these examples demonstrate self-organising, -managing, -healing, -coordinating and -regulating properties.

In this thesis, we are interested in adaptive systems whose environment explicitly includes a set of conventional (mutually agreed) rules, and in the behaviour of system components that seek to comply with or modify that set of rules. The specific work we will build on is the approach based in self-organising electronic institutions [133, 134], itself rooted on a computational logic formalisation of Elinor Ostrom's institutional design principles [122] as a set of conventional rules.

5

MACS

5.1 Introduction

With insights from the inter-disciplinary analysis of literature and the surveys, requirements were defined for a new system that would attempt to avoid, reduce and resolve situations of workplace incivility, hence improving the quality of experience in shared workplaces. That system was named MACS, M—'s Affective Conditioning System, and this chapter will describe the system and its design, architecture and implementation.

Incivility is considered to be a minor workplace deviance, but often escalates into more serious problems, such as conflict and aggression [3]. Furthermore, workplace incivility can increase people's anger, fear and sadness, that lead to direct or indirect aggression towards the first instigator [137]. Besides the negative outcomes towards other people, incivility also has negative consequences for the people it targets, such as diminished productivity and motivation, absenteeism, stress and intentions to quit, among others.

According to Leiter [100], incivility is a contemporary workplace crisis, and the entry level form of workplace mistreatment. Therefore it is expected that by targeting incivility, as a first level of deviance, MACS will help to reduce situations of further and more serious workplace deviance. Additionally MACS is expected to promote self-awareness, compliance to mutually agreed on norms, and general feeling of well-being and belonging in the office space.

MACS is named as an analogy to an air conditioning system, as its overall aim is to restore a homoeostatic equilibrium in the workplace. The system takes into consideration the affective states of the people who share the workplace, the social norms defined for

the workplace and anonymous flagging of violation of those norms. Additionally, it allows for people who violate the social norms to apologise for their behaviour.

This chapter will describe MACS and all the relevant aspects of its creation and development: Its design, which has led to the presented architecture, implementation and database.

5.2 Definitions

We have created a fictional scenario to help exemplify what is expected from the following sections in this chapter. Some definitions of concepts that are relevant both to the scenario and the following sections in this chapter will be described next, and the fictional scenario will be presented afterwards.

- Social norms – Social norms are rules of behaviour for the workplace, defined by the people who will share that workplace. Social norms are used in MACS in the format:

  > *Social norm*: "Keep the mobile phones in silent or vibrating mode".
  > *Description*: "Mobile phones should be kept in silent or vibrating mode at all times, as otherwise, they might cause distractions in the workplace".
  > *Category*: Noise.
  > *Severity*: Critical.

- Offender – Person who has broken a social norm in the workplace.
- Victim – Person who has flagged someone else's violation of norms in MACS.
- Episode of incivility – An episode of incivility happens when someone breaks an established social norm and one or more people flag that violation of the norms in MACS. Later in this chapter we will explain how an episode of incivility is implemented in MACS: As an event group, which is composed of one or more events, where an event is an atomic occurrence of one victim flagging one offender for having broken one social norm at a given time. All events in an event group have the same offender, the same broken social norm, and a small time window, but a different victim.

- Reputation – At any given time each person in the workplace has a reputation that ranges between -100 (unacceptable) and 100 (excellent). Regardless of any other interactions, reputations start at 0 (neutral) and increase gradually throughout time. Depending on the occurrence of episodes of incivility, reputations are decreased with violations of norms, and increased when people apologise and their apology is accepted.

- Event group score – This score is the result of fuzzy logic calculations of the way variables regarding an event group interact (which will be explained later in this chapter), and represents the likelihood of the episode of incivility to have happened.

The following fictional scenario describes an episode of incivility in a workplace and the co-workers' interaction with MACS in order to try and solve it:

> Mary, Jane and Charles are regular MACS's users and they share a room with ten other people. Today Mary's reputation is 15 (positive). Mary has left her phone on her desk and has left the room. Her phone has rang for 30 seconds while she was away. One of the social norms in their workplace is "Keep the mobile phones in silent or vibrating mode.", so she has broken that norm. Jane and Charles flag Mary's violation of the norm in MACS.
>
> Since multiple people can flag the same violation of norms, MACS allows two hours before calculating the score of an episode of incivility, so that it can merge several people's reports of a violation of norms. Therefore, two hours later MACS calculates the score of this episode of incivility. This score is based on the reputations of everyone involved, i.e. Mary (the offender), and Jane and Charles (the victims), the amount of times Mary has broken this norm before, flags previously raised between Mary and the two victims, in situations where Mary was either the offender or the victim, and the number of people who have flagged the same event. If the score is higher than 50% the event is validated and activated. MACS calculates a score over 50% and therefore Mary's reputation is decreased to 5 (neutral). The value by which the reputation is decreased is based on the score, with highest scores decreasing reputations by higher values.

Mary is notified that she has broken that social norm and that two people have flagged her behaviour. She decides to apologise on MACS, though not knowing who the two people who have flagged the violation of norms are. She apologises and adds the explanation "Sorry, I completely forgot to put my phone on silent mode.". Jane and Charles are notified of the apology. Jane decides to accept the apology, hence forgiving Mary, but Charles feels that Mary has done this several times before, so he doesn't feel her apology is sincere, and therefore decides to ignore it.

At this point, since all victims have either accepted or ignored the apology, Mary's reputation is re-assessed by MACS. Only one of her colleagues has accepted her apology, therefore her reputation increase is only half of what it would have been if both people had forgiven her. Therefore, of the possible 8 points her reputation could have increased by, it increases by 4, to a value of 9, which is labelled as neutral.

So by breaking the norms her reputation has decreased. By apologising and then being forgiven by one of the victims, it has increased slightly. Even if both Jane and Charles had forgiven Mary, the new reputation would always reflect a violation of the norms, meaning it would never be increased by as much as what it had been previously decreased for.

5.3 Requirements

MACS provides a computer-mediated interaction between people in the workplace, especially between people who are affected by someone else's behaviour (the victims), and the person or people who behave in a way that upsets other people in the workplace (the offenders) [150].

Each workplace has a set of social norms that range from being officially imposed by the company and clearly stated, to being mutually agreed on between co-workers and tacitly known. Different workplaces abide by different sets of norms. These norms might change throughout time, new norms might be created and some norms might be removed.

Before MACS is installed in a workplace, the social norms need to be clearly defined and agreed on between co-workers. This means the norms are customisable for each workplace. Norms are not stable by nature and, as time goes by, they might need to be

adapted to reflect the workplace's needs. They can be created, deleted and changed by a voting system in MACS, in which all co-workers have the right to participate. This embodies, in a socio-technical system, the socio-economic institutional design principles of Ostrom, which state that those affected by rules have the right to modify them [122]. This will be further explained in section 5.4.3.

The system also includes decision-making tools, which control all feedback provided, such as, for instance, emails warning the offenders of their inadequate behaviours. These decision-making tools will receive as inputs:

- The reputations of everyone involved in the event – offender and victim(s),
- the social norms,
- the number of people flagging the same violation of norms,
- historical data about recidivism (for the offender),
- historical data about previous interactions between these same offender and victim(s) – with the same offender/victim roles, or switched roles, where the now offender was the victim then, and the now victim was the offender then.

A score is calculated for each event, based on these inputs, as described in Section 5.5.6 and explained in detail in Section 5.6. Figure 5.1 shows the conceptual model of an episode of incivility being reported in MACS. There are as many events as the number of victims and they all compose an event group.

Given the system's automated reasoning and decision-making on what is signalled as a violation of the norms, classification errors might occur occasionally. Since the offences are always flagged by people who share a workplace, and the system then decides whether or not to label flagged events as violations, if classification errors happen, they are expected to happen because the system was too conservative in considering something as an offence, rather than classifying an innocuous action as a violation.

MACS needs to provide a solution for people who are too introvert to let someone else know they are upsetting them, to indirectly do so. The interaction is, therefore, anonymous, to avoid lack of participation due to, e.g., hierarchical relationship between victim and offender, or fear of retaliation from an aggressive co-worker. Many times

people have to work with colleagues they don't get along with, so co-workers often "butt-heads with one another", but the office pariah is frequently the boss [121]. By providing anonymous flagging of norm violations, MACS allows for people who might feel inhibited by direct confrontations, not to feel constrained in signalling offences.

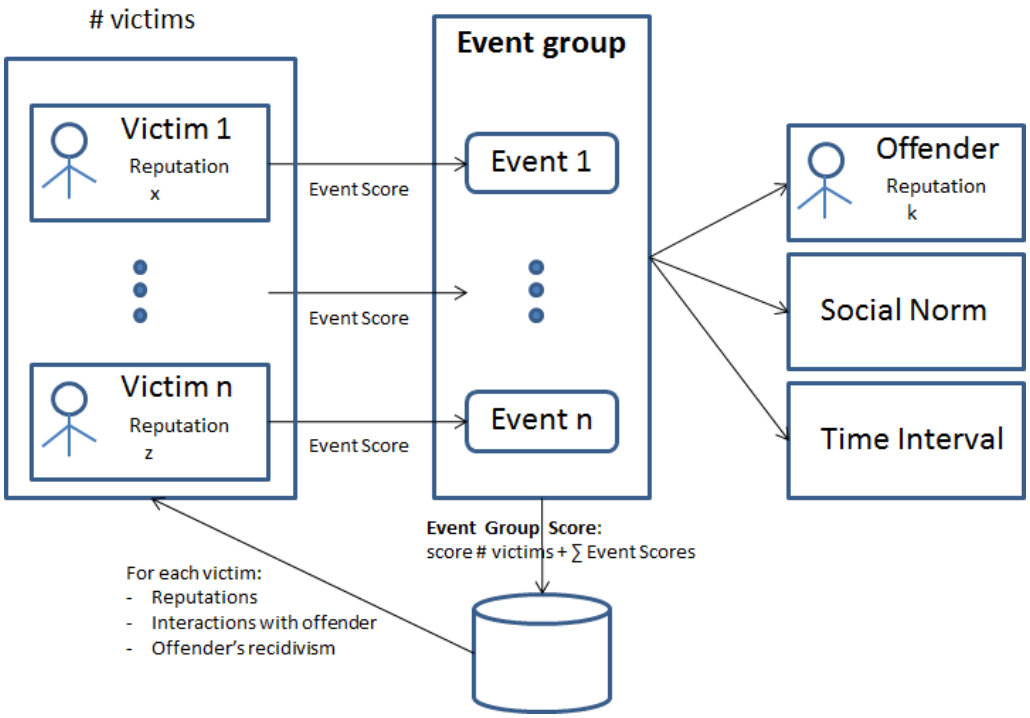

Figure 5.1: Conceptual model of an episode of incivility (event group) in MACS.

All violations of norms are reported by the people who share the workplace. In order to have an automatic detection of these offences, there would have to be automatic video analyses, which are not part of the scope of this study.

Figure 5.2 shows the activity diagram for an event life-span – from the moment it is created, by a person flagging someone's violation of norms, to the moment it is closed, either because MACS did not consider it to be a valid event, or because it went through all the process of apology/explanation followed by forgiveness/ignoring the apology.

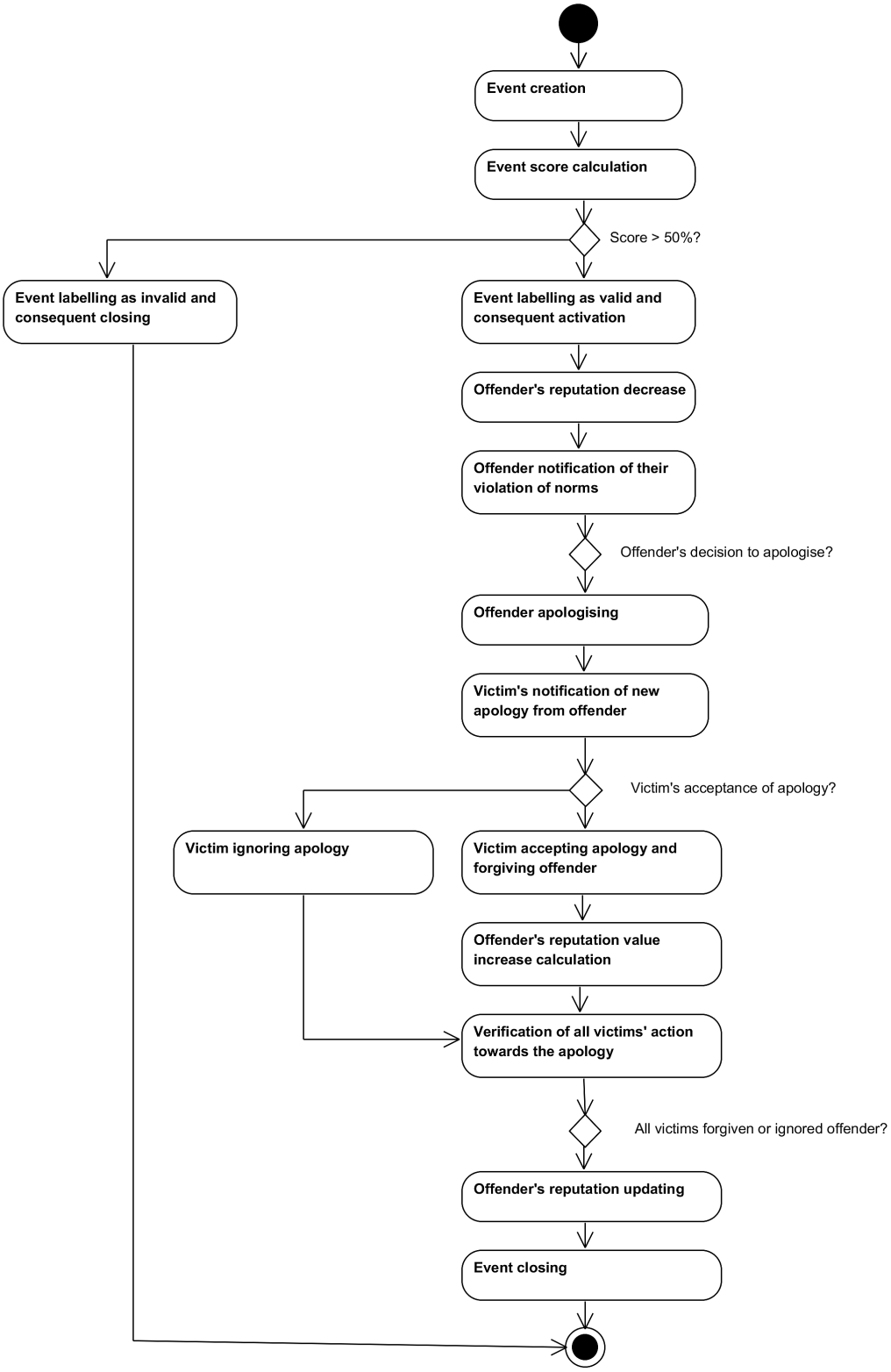

Figure 5.2: UML Activity Diagram of an event life-span.

The system can also collect and relate data, such as:

- Who the offenders are (who has ever broken a social norm),
- how often each offender breaks the social norms,
- how many people flag the same offence,
- how the offenders react to negative feedback from the system (whether or not they try to change their behaviour, whether or not they provide an explanation for it, etc.),
- how the victims react to the redeeming behaviour from the offender.

Additionally, the system keeps every employee informed about the social norms and their personal level of compliance with them. For instance, a person who has never broken a social norm has a higher level of compliance than someone who has been an offender before. This is reflected in each person's reputation.

MACS will be explained in detail in the sections that follow.

5.4 Design

The design of MACS has to encompass the following components:

- Events – Episodes of incivility that are reported in MACS.
- Actors – The people involved in an event, i.e. victim(s) and offender.
- Expression and adaptation of social norms – Social norms are determined by people who will abide by them. Norms are not, however, static, and might evolve or change completely through time. It is, therefore, important that MACS allows flexibility in creation and maintenance of norms, so they can be adjusted to the current reality of the workplace they are being used on.
- Reputation - Having a reputation system is a good way to evaluate people's behaviours, both for helping to assess the likelihood of a claim of uncivil behaviour being true, and for management to be aware of people who might be decreasing the quality of experience in the workplace, by regularly breaking norms.

- Indication of unavailability – To try to minimise interruptions when people are most stressed or trying to concentrate, MACS provides the option of an indication of a "busy status" that can be activated by each of the people in the workplace and is visible to everyone.

- Reasoning – This gathers all the available data about an episode of incivility, namely reputations of the victim(s) and offender, historic data about the same offender having broken the same norm, number of people reporting the same uncivil behaviour and previous interactions between the involved parties, and calculates the probability of a reported violation of norms being valid.

- Apology and forgiveness – As explained on Section 2.5, when an offender presents an apology, that can increase the empathy the victim feels for them, therefore increasing the victim's motivation for forgiveness [110]. Since MACS aims at restoring the homoeostatic equilibrium in the workplace, it should include means for facilitating apology and forgiveness, consequently promoting a better working environment.

Each of these components are better detailed in the following subsections.

5.4.1 Events

An episode of incivility might encompass several victims flagging one person's violation of a social norm. In MACS, this should be seen as an event group, containing as many events as the number of victims. Therefore, an event in MACS should be an atomic flagging situation, by a single victim, of violation of a social norm, committed by an offender.

An event should be started when someone flags a co-worker's violation of norms. If multiple events refer to the same episode, they should all be associated with the same event group.

5.4.2 Actors

There should be three actors in the system: the victim, the offender and the manager. Both the victim and the offender should be people who share the workplace MACS is installed in, which means a person could be simultaneously a victim and an offender at two different events.

A regular user should be able to double in the roles of victim and offender, and to play both roles at the same time. A user would take the role of the Victim when, having been affected by someone's violation of norms, they would flag this on MACS, and MACS would consider this to be a valid claim. They would take the role of the Offender when someone would flag their behaviour and MACS would evaluate that event as valid.

Regardless of the role they are playing, users should be able to login to MACS, toggle their "busy" status on/off, check the social norms, vote for or against them, and suggest new norms. They should be able to check historical information of previous episodes where they broke the norms, and to check their own reputation and its evolution for the previous ten days.

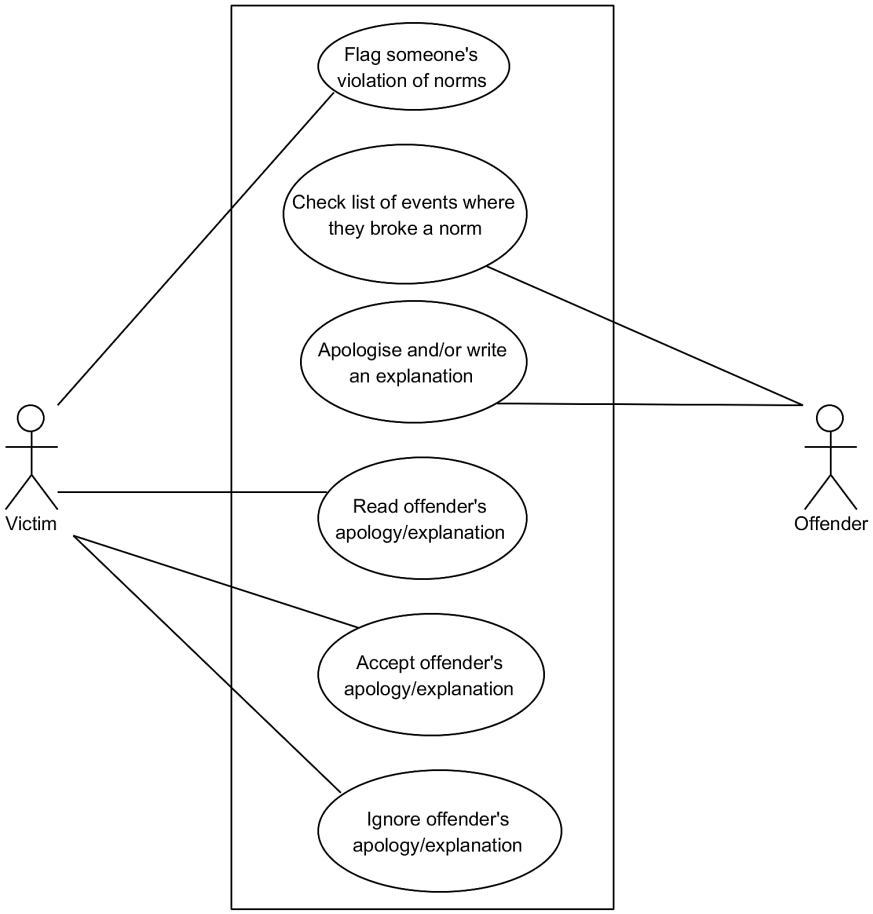

Figure 5.3: Use case for a new event.

Depending on whether they are a victim or an offender, users should be able to perform the additional tasks:

- Victim – victims should be able to flag someone's violation of norms, read apologies/explanations from the offenders, and accept or ignore these apologies/explanations.
- Offender – offenders should be able to check the list of events where they've broken a norm and how many people have flagged each event. They should be able to apologise and write an explanation for each of these events.

Figure 5.3 shows the use case for the Victim and Offender actors, throughout the life span of an event.

The remaining actor is the manager. The manager can be anyone in the company who does not share the workplace with the regular users, but has knowledge privileges and/or management rights over those people. It could be, e.g., a Human Resources Manager, or the person regular users report to. It is very important that the manager does not share the open-space with the remaining users, as it would represent a conflict of interests. Since the flagging should be anonymous, the manager being in the open-space would mean they would double as a regular user and a manager, having access to all events, and therefore knowing who had flagged their behaviour.

On login, managers should be directed to an administration page, that is password protected. There, they should have access to private information about all the events currently open, details about events and people, listings of events ordered by offender, victim, social norm, etc. Managers should also be able to add, edit, enable or disable social norms, and check norm suggestions from the employees.

5.4.3 Expression and adaptation of social norms

The first thing to do when setting up MACS at a new shared workplace should be to define the initial set of social norms. Norms should be gathered by using questionnaires, interviews and focus groups with the employees, and need to have (preferably) everyone's approval to be defined as the social norms everyone should abide by. An example of a social norm would be:

Social norm: "Keep the mobile phones in silent or vibrating mode".

Description: "Mobile phones should be kept in silent or vibrating mode at all times, as otherwise, they might cause distractions in the workplace".

Category: Noise.

Severity: Critical.

MACS should have a voting system for social norms, which would allow for everyone who uses it to vote positively or negatively for a norm. It should also allow people to suggest new norms. The dynamic nature of offices might mean there is a constant need to change norms, so MACS should provide flexible ways of either changing norms frequently, or settling for a set of norms and abiding by them permanently.

Whenever a new social norm or a change in an already existing social norm is proposed, there has to be a high level of agreement between people who are affected by them, for it to be implemented.

MACS should display all the social norms that are in force for the current workplace it is installed in, so everyone is perfectly aware of the norms they are supposed to abide by, and how critical the violation of those norms is.

5.4.4 Reputation

Reputation should be another variable for validating an event. The reputations of the parties should always be analysed when a new event is created on MACS.

Each person should have a reputation that starts in a neutral state and then would evolve over time. It should slowly progress to a more positive value, provided no negative action (i.e., a violation of norms) happens. The result of this process would be people who are consistently civil end up having a very good reputation, and people who occasionally break norms do not permanently keep a negative reputation.

Whenever there is a violation of norms the reputations of the victim and the offender should be analysed. The better the victim's reputation and the worse the offender's reputation is, the more likely it should be the event is valid. If MACS considers the event to be valid, the offender's reputation should be decreased by a value that would reflect the score calculated for that event. The highest the score, the highest the factor by which the offender's reputation should be decreased.

After an episode of incivility is flagged on, and validated by, MACS, the offender should always be offered the opportunity to apologise (in MACS). This should lead to

the victim(s) accepting or ignoring the apology. The apology/forgiveness process will be explained in section 5.4.7, but when it comes to its effect on reputations, if the victim forgives the offender, their reputation should be increased by a percentage of what it had been decreased for.

Each person should be shown, in MACS, their current reputation and reputation evolution for the previous ten days. They shouldn't have access to their co-workers' reputations, to protect each individual's privacy and avoid a stoning effect.

Resnick and Zeckhauser [140] and Khopkar et al. [93] have identified the stoning effect as a phenomenon happening on eBay's reputation system: Buyers are more willing to "cast another stone" at a seller who already has a disreputable reputation. This could happen for two reasons: People might be willing to forgive a single bad behaviour, but want to punish sellers who show patterns of bad behaviour; buyers may interpret what happened in their own transactions differently, depending on the suspicions raised by the seller's previous feedback [93].

The same concept may be associated with MACS's reputation system. We would like people to flag violations of norms based on their own assessment of the situation, and because they felt affected by someone's behaviour, rather than doing so because they have been influenced by the knowledge that the person in question has a bad reputation.

The only person who should have access to everyone's reputations would be the manager. They could use people's reputations as an indicator of norm-compliance, and be aware of who might be creating problems for the general office harmony.

5.4.5 Indication of unavailability

Behaviours related to "interruptions" were the third most mentioned issues in the questionnaire (previously explained in Section 3), with 16% of the respondents referring to them. People indicated interruptions are particularly annoying when they are very busy or trying to concentrate, and referred to how hard it is to let others know they don't want to be interrupted, and successfully passing on the message, without sounding rude. So the vast majority of people who've indicated interruptions is an issue, hasn't mentioned any personal strategies to solve the problem. From the few strategies pointed out in some scattered answers, people have mentioned using headphones to make it harder for someone to approach them, or using body language to show they are busy.

Even though it is impossible to avoid interruptions at all times, MACS should provide a simple solution for, at least, attempting to reduce them. Each user should be able to easily toggle an indicator of their busy status on and off. This means everyone in the workplace would be aware of who is busy and doesn't want to be interrupted. As everyone would know this is a flag posted by their co-workers, if they are respectful, they are expected not to interrupt them with minor issues, and additionally this might have impact on preventing other violations of norms. E.g. if someone was about to be noisy and realised someone else has a "do not interrupt" flag up, they might stop and leave the room, and make noise outside, instead.

In order to avoid people putting up the busy flag and then forgetting about it, keeping it for days, therefore defeating the purpose of having it in the first place, the busy status should be automatically reset every night. Even if a person is in a state where they would prefer not to be interrupted for a few days, making them consciously toggle the busy status on daily, would represent more of a deliberate expression of their mood/situation.

5.4.6 Reasoning

MACS should weigh several variables before determining the likelihood of an event being valid. These variables – some explained in the previous sections – should be reputation of victim(s) and offender, number of people flagging the same event, previous episodes where the same offender has broken the same social norm and previous interactions between the victim and the offender (with the same or reverse roles).

The calculations made by the Reasoning module should be done in several iterations, as it would not be possible to calculate a full episode's score as soon as an Event is created. This happens because, as explained earlier, an Event, in MACS, is an atomic occurrence of a violation of social norms, with a single victim. Several victims might report the same episode, but since they might not all report it at the same time, the Reasoning module should allow some time to pass before analysing multiple inputs for the same episode and calculate a final score for the event or event group. We decided to use two hours, as an initial value, as we considered it should allow enough time for everyone affected by a violation of norms, to report it. This value can, however, be easily adjusted, if by using MACS for a while, users feel it is inadequate.

5.4.7 Apology and forgiveness

The final part of an event should be the one concerned with an apology or explanation, and a consequent potential forgiveness.

Section 2.5 has described forgiveness as a psychological process between humans, and its reflection in CMC. The decision to forgive someone after a transgression is influenced by various psychological factors, which include empathy for the offender, positive appraisals of the offender and rumination about the transgression; and by factors related to the offence, such as severity of the offence and offender's recidivism. Empathy for, and positive appraisals of the offender make it more likely the victim will forgive them, whereas rumination about the transgression, high severity of the offence and recidivism make it more unlikely, as negative thoughts and images about the offence tend to hinder forgiveness [110].

In CMC, it has been shown that when an offender has the opportunity to apologise and repair the action that caused the violation of norms, the victim's trust can be restored [162].

MACS is in a hybrid setting, in the sense that even though people are working in the same physical space and interacting with each other in person, when it comes to reporting incivilities and forgiving people who break the norms, the interaction should be computer-mediated by MACS. This means that in this particular case, even though forgiveness would always be awarded in a CMC way, the cues that would lead to it would come from both MACS and personal interaction.

Low self-awareness in certain settings might hinder an offender's experience of shame, guilt or embarrassment. By providing people with information about norms and how well they comply with them, MACS would be providing cues for everyone to be more aware of how they affect the overall environment. When someone breaks the norms and is notified by MACS, they might apologise (in MACS), and also display expressions of embarrassment on their faces. Both the apology and the expression of embarrassment should make it more likely for the victim to empathise with the offender, therefore increasing the chances of forgiveness.

This makes the apology/forgiveness section of MACS a fundamental one, as it is expected to be the mechanism that would most contribute to restoring relationships between co-workers, therefore returning the office environment to an homoeostatic equilibrium.

Whenever a reported event is considered to be valid, the offender should be notified and be able to see their violation of norms in MACS. Even thought they would not know who had flagged their behaviour, they would be made aware of how many people had flagged it. They would then be given a chance to apologise and/or explain what happened. This information would then be sent to everyone who had flagged the behaviour, who could then accept the apology/explanation. If the victim accepts the apology, thus forgiving the offender, the offender's reputation should not be entirely restored, but should be increased considerably. Each victim should see the apology/explanation individually and not be aware of how many other people might have flagged the same incivility episode.

5.5 Architecture

MACS was designed as a web-based system, so that it would be accessible without the need to have any software installed in each user's computer. It is composed of:

- An Interface layer (HTML, CSS, PHP, JavaScript), accessible by a web browser and the only point of communication between the user and MACS;
- the Events, Affective Interaction, People, Social Norms, Reputation, Reasoning and Forgiveness modules (PHP) – that work together to compute the process and outcome of each episode of incivility, from the moment it is flagged, to the moment it is closed;
- a database handler (PHP, SQL), which provides access between the database and the remaining modules, so that communications with the database are all made through this class;
- and the database (MySQL).

Figure 5.4 shows the UML Components Diagram of MACS's architecture. The top layer is the interface and it communicates with all other modules. All users only interact with the interface when accessing MACS. The several modules, described in the following sections, communicate between themselves, the interface component, and the database handler. Finally, the database handler is used as an interface between the database and all other components of MACS.

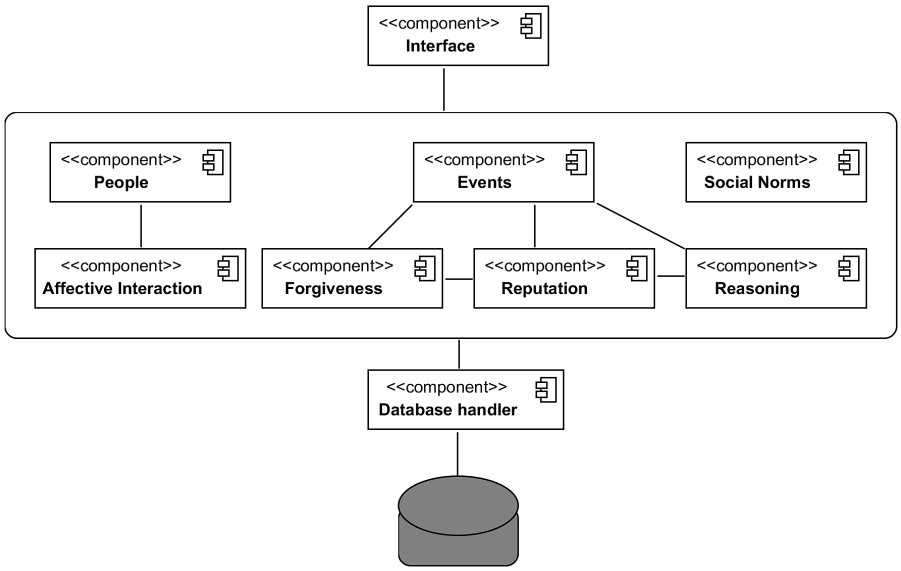

Figure 5.4: UML Components Diagram of the MACS's architecture.

The following subsections will describe MACS's modules.

5.5.1 Events module

An event in MACS is an atomic episode of incivility, committed by an offender, in violation of a social norm, and flagged by a single victim. The same episode of incivility might be flagged by multiple people, but for each one of the victims, a new event is created. If events are related, they are later joined together in an event group.

Whenever a person flags a violation of norms in MACS, the Events module receives inputs from the Interface to create a new event: victim, offender, social norm, date/time, and some (optional) additional information entered by the victim. As it creates a new event, it checks recent events for matching details for offender, social norm and time range, and if it finds a match, it joins them together in an event group.

An event always starts with an active state 0, so that it isn't presented in MACS without having first been evaluated for validity by the Reasoning module (explained in section 5.5.6). Only events or event groups with active state 1 are presented in MACS.

As soon as an event is created, the Events module makes the first call to the Reasoning module, sending it data about the current event and previous events regarding both victim

and offender, either playing the roles of the victim and the offender, respectively, or the opposite roles. The Reasoning module returns a score for the current event.

Every fifteen minutes a scheduler calls the Reasoning module. The Reasoning module checks for events or event groups that have happened over two hours before and are waiting for a score, and when it finds a match, it calculates a final score for the event or event group, and returns it to the Events module.

The Events module can then either activate the event or event group, or close it without ever activating it, depending on whether the score is higher or equal to, or lower than 50%, respectively. Each event group is composed of several events, but when presented in MACS, it is displayed as a single event, with multiple victims.

Each single event has a status, that starts at 0. If an event/event group is considered valid and therefore activated, the event or events that are part of the event group change the individual status to 1.

When an offender apologises, the Events module updates the event/event group to reflect that action. The status of each event that is part of an event group is updated to 2. Consequently each of the victims is notified, on the Interface, about the apology/explanation. The victims can, then, individually, decide whether to accept the apology and forgive the offender, or ignore their apology. These actions are reflected on each event's status. An event/event group can only be closed when the statuses of all events involved are either 3 (forgiven) or 4 (ignored). A scheduled task will check, every fifteen minutes, for events that are ready to be closed, and when it finds one, it calls the Events module for this final update.

The Events module also provides all information used in the manager's view in MACS. The manager's home page presents all open events at the time of login. Open events are those that have been validated as episodes of incivility and are either waiting for the offender to apologise, or waiting for all victims to either forgive the offender, or ignore their apology.

The manager can order the open events view by victim, offender, social norm, number of victims, date and status (either waiting for offender's or victims' actions).

5.5.2 People module

The People module manages all data relating to all MACS's users. It is used to present each employee's avatar, and to retrieve all information about a single person.

On the regular user's interface of MACS each person only has access to their own details. They are presented with avatars of their co-workers and they can click on them, to flag their uncivil behaviour, but no details are provided about each person they share the workplace with, apart from their name and avatar.

On the manager's view, on the other hand, the details of every regular user who interacts with MACS are available. The manager can access a person's details page either by clicking on their avatar through MACS, or by clicking on the "People" tab on the top navigation menu.

The People module returns employee's full name, contact details, date of employment, current reputation and the reputation evolution graph and the list of norms they have voted on – either positively or negatively.

5.5.3 Social Norms module

The Social Norms module is concerned with everything related to social norms, including creation, change, disabling, votes and suggestions of new norms.

Each workplace has a different set of social norms everyone has to agree on. People also need to agree on a severity for the social norm from the options:

- 1 – Very critical
- 2 – Critical
- 3 – Average
- 4 – Minor

Social norms are workplace-dependent and customisable in MACS. Despite the initial agreement on a set or social norms, norms are not necessarily static, which means people can suggest new norms to be included and current norms to be removed.

Regular users can only vote for existing social norms and suggest new norms. The manager is the only actor who can change, disable, enable and create social norms. They can also access all suggestions for new norms regular users have made, and create new norms from the suggestions.

5.5.4 Reputation module

The Reputation module manages the variation in the reputation status of each of the employees in the workplace. In the beginning everyone's reputation is neutral, but as time goes by and events start to be reported, negative changes in offenders' reputations, and positive changes on the reputations of people who do not break the social norms, start to happen.

This module interacts with the Events and the Forgiveness modules. When a new event is reported and its score is calculated, if the score is over 50% the event is considered valid, and the offender's reputation is decreased by a factor that relates to both the score and the severity of the offence. The highest the score and severity, the highest the factor by which the reputation is decreased. This means that reputations are affected not only by recidivism and personal interactions between offender and victims, but also by the severity of the offence.

When an offender apologises, if at least one of the victims forgives them, their reputation will be increased. If all victims of an incivility episode forgive the offender, the factor by which their reputation is increased is high, but never as high as the factor by which it was decreased.

Reputations increase throughout time, which results in people who never break the norms having an increasingly positive reputation, and people who occasionally break them, not being stuck forever at a negative reputation. If they do not re-offend, their reputation will slowly go back to the neutral status and eventually become positive.

MACS's interface displays a graph of the reputations' evolution. This graph is designed using Google Charts [1]. Google Charts was chosen because it is free, easy to implement and customisable, so it provided the simplest effective solution.

5.5.5 "Busy" status module

The "Busy" status module implements a self-reported indication that a person is busy. If people feel they do not want to be interrupted, they have a 1-click toggle to turn a busy state on and off in MACS. This is intended to create awareness, mainly to avoid interruptions. Still, it might also make people more aware that, as others are very busy or trying to concentrate, if they break norms, that might upset them even more than it

would, in times where other people haven't specifically stated they do not want to be interrupted.

5.5.6 Reasoning module

The Reasoning module is the most complex module in the MACS's architecture, as it is the one that adds intelligence to the system. This module works with inputs from the Events and the Reputation modules, relating them in a fuzzy logic algorithm, in order to infer the probability of an event being valid. This probability is reflected in the calculated event's score. The choice of fuzzy logic was based on the fact we need to deal with uncertainty, and fuzzy logic allows for a degree of truth, rather than a binary result of true or false, so it seemed like a good choice.

Figure 5.5 shows the UML sequence diagram of the first instance where the Reasoning module is used, once an event is created. The Reasoning module is used a few more times during the life-span of an event, which ranges from the moment someone flags someone else's violation of norms and a new event is created, to the moment the event and all the events on the same group that event belongs to, are closed.

Multiple people might report the same episode, and when that happens they are grouped together in an event group. Since not all people might report a violation of norms at the same time, each event is analysed on its own, on a first instance, and two hours later, information about multiple people having flagged the same episode, is added, so the final score for the event group can be calculated. This will be explained in Section 5.6.

The diagram in Figure 5.5 shows the action sequence for calculating the first partial score. This score is calculated as soon as an event is created and takes into consideration the components of the score that are only dependent on a single victim and the offender. These components are retrieved from the Events and the Reputation modules.

The inputs received from the Events module relate to atomic occurrences of a violation of social norms, i.e., as explained before, each event is an episode where a single victim has flagged an offender's violation of a social norm. The Events module provides:

- The broken social norm,
- the date/time when the social norm was broken,

- the victim,
- the offender,
- an optional text input the victim might have written while reporting the episode, adding more information about it.

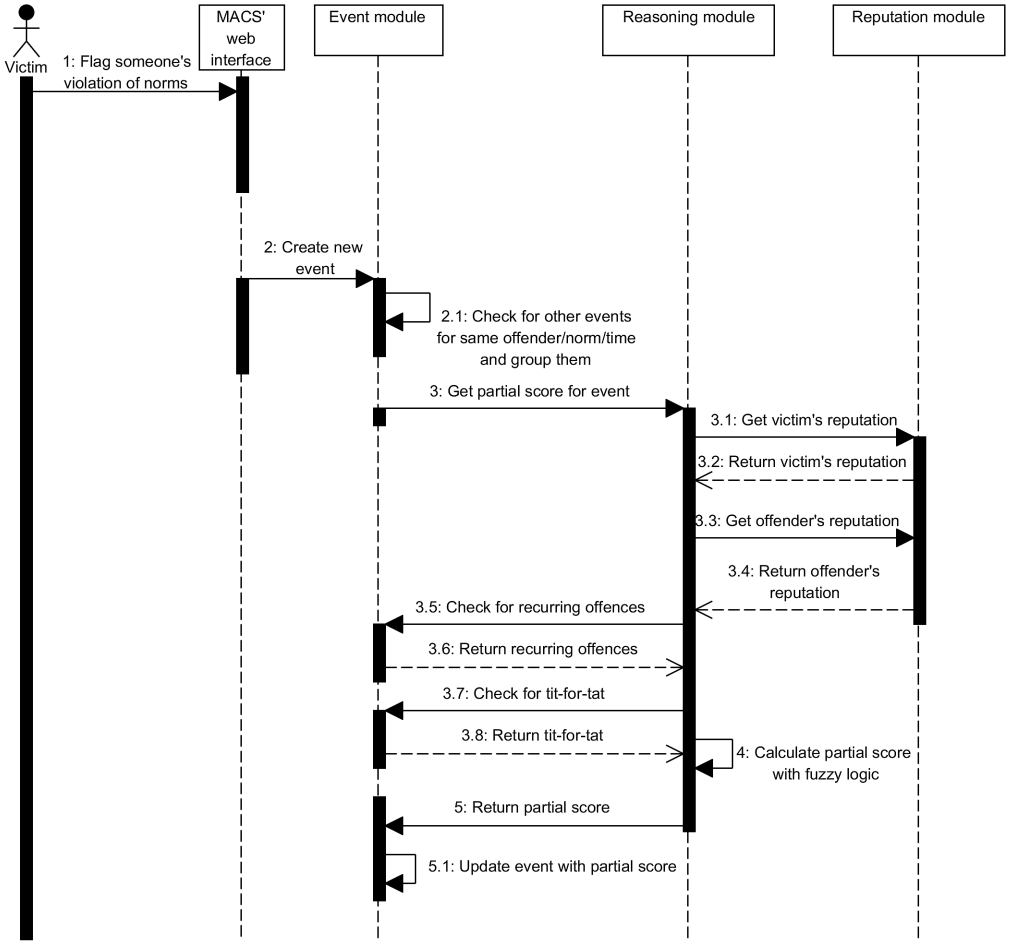

Figure 5.5: UML Sequence Diagram for the calculation of an event's partial score, once a new event is created.

The inputs received from the Reputations module are simply the victim's and the offender's reputations at the time the event occurred.

Point 4 in the diagram in Figure 5.5 is the calculation of the partial score using fuzzy logic. This partial score calculation is made based on the victim's and offender's repu-

tations, recidivism and previous interactions between the victim and the offender. The whole algorithm used is explained in Section 5.6.

The highest the victim's reputation is and the lowest the offender's, the higher the score. The opposite happens for victims with low reputation and offenders with high reputation. A reputation reflects the amount of times someone breaks the norms in the workplace, so even though it is not an accurate proof of someone's guilt, it can be seen as a good indicator. The reputations are the second factor of highest impact on the score (the first is multiple people flagging the same episode).

Many times people break the norms out of ignorance or lack of self-awareness – they do not realise their actions might be annoying. As MACS presents norms clearly, it should help people to be aware of the norms that are in force in the workplace. It should also create self-awareness, as when people break the norms and someone flags it, the offenders are informed that they have broken a specific social norm. If they do it multiple times after a first episode, it means they are fully aware of their actions, but they still continue to break the norms, and this is an intentional or careless uncivil behaviour. So the measure of recidivism is very relevant for the score, as it indicates potential conscious disregard for the norms. Logically the more a person has broken a norm, the more it will weigh into the score.

The factor that weighs the least on the final score is the interaction between the two parties, i.e., the amount of times the victim has flagged the offender, and the amount of times the offender has flagged the victim, in the past. This factor might indicate previously existing issues between the two people, rather than the victim having truly been affected by the offender's action, therefore having a lowering impact on the score. The highest the interaction between victim and offender is, the lowest it will add to the score. This factor is the least reliable one, hence its lowest weight on the score, as even though people flagging each other's behaviours often might mean there is a potential conflict going on between them, it might only mean both people break the norms frequently, and flag violations of norms often.

The factor with the highest impact on the final score, multiple people flagging an episode, can only be calculated two hours after the event has been flagged in MACS, by its first victim. This two hours interval is intended to allow people to flag violations of norms in their own time, as it is not likely all victims will flag an event at the exact same time. After two hours have elapsed, the final score is calculated and the event is

either ruled as non-valid and never activated, or ruled as valid, activated and presented on MACS. At this stage, the Reasoning module has merged all partial scores and calculated the final score, considering the number of people who have flagged it. Multiple people flagging the same violation of norms, by the same offender, at the same time, is a very good indicator that the alleged violation of norms did happen.

5.5.7 Forgiveness module

The Forgiveness module has two main components, one on the side of the offender – the apology/explanation, and the other on the side of the victim(s) – the forgiveness. These components are connected as forgiveness only happens if it is preceded by an apology.

This module is the only module in MACS that isn't always used. If the Reasoning module rules the event as invalid, the event is closed and the Forgiveness module is never called. Otherwise, it is called after the Reasoning module rules an event as valid and presents it as an open event on MACS.

Figure 5.6 shows MACS' sequence of actions after the Reasoning module has determined a positive score for an event. The event is presented to the Offender and they can apologise and explain their behaviour. If the Offender decides to do so, each Victim is notified of the apology and can check it in MACS. The victims can either accept the apology, hence forgiving the offender, or ignore it, therefore not forgiving the offender.

When a victim forgives the offender, the offender's reputation is increased by a fraction of the value it was decreased for. There is a maximum value x by which the offender's reputation can be increased. In n victims, for each victim who forgives the offender, the offender's reputation is increased by x/n.

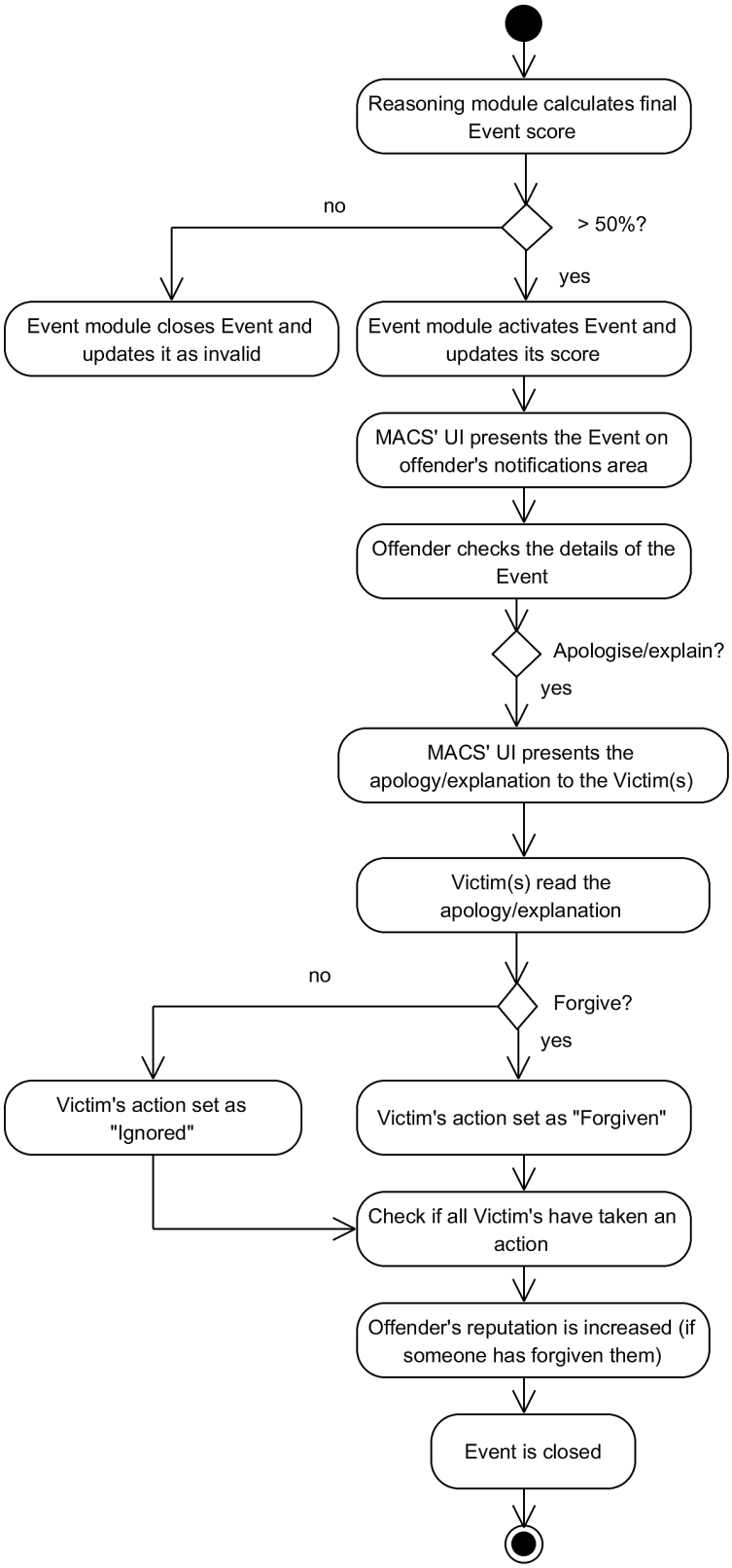

Figure 5.6: UML Activity Diagram for the apology and forgiveness process.

5.5.8 Database handler

The database handler is a class created to manage all access to the database. By having a sole point of access to the database, database accessing and querying errors are minimised and the rest of the code is completely separated from the database.

5.6 Implementation

This section will describe the steps in building the reasoning process in MACS. The method in which we implemented the fuzzy calculation of events' and event groups' scores in the reasoning module, as described in Section 5.5.6, will be presented next.

As explained before, the calculation of an event's score is made as soon as the event is reported in MACS. However, an event is part of an event group, composed of all the events regarding a same episode of incivility, i.e., an event group is composed of one of more events. To allow for all victims to flag an episode of incivility, the event group's score is calculated two hours after the first instance of an episode has been reported, which means an event's score can never be finalised before that last check. We assumed this amount of time as an acceptable window of time for people to flag an episode of incivility, after it happens, as for some reason they might not be able to do it as soon as it happens. This can be adjusted for different workplaces.

Several fuzzy inference systems, named FIS and numbered 1 to 4 for ease of understanding, are used in the calculation of the scores. FIS1 to FIS3 are event-related and are calculated as soon as an event is reported, and once for each event that constitutes an event group. FIS4 is event-group-related and calculated two hours later, and only once for the event group. FIS1 deals with the reputations of the victim and offender in an event, FIS2 with the offender's recidivism and FIS3 with historical interactions between victim and offender. FIS4 calculates the impact of multiple people flagging the same episode of incivility. These FISs will be detailed later, and the following formulas and Figure 5.7 will clarify how they are used.

The formula for calculating an event score *(EventScore)* is:

$$\textbf{EventScore} = \frac{0.80 \times FIS1 + 0.65 \times FIS2 + 0.40 \times FIS3}{0.80 + 0.65 + 0.40} =$$

$$= 0.432 \times FIS1 + 0.352 \times FIS2 + 0.216 \times FIS3$$

The formula for calculating an event group score *(EventGroupScore)* is:

$$\textbf{EventGroupScore} = 0.35 \times FIS4 + 0.65 \times (\frac{\sum_{i=1}^{n} EventScore_i}{n})$$

We have decided that each of the FISs regarding an episode of incivility should have a different weight on the score, based on their importance, relevance and degree of certainty they add to the equation. The weights are visible in the formulas above. The FISs, ordered by weight, are:

- FIS4 - Number of people flagging the same episode of incivility – this is a quantitative and independent variable, as the higher the number of people flagging a same episode of incivility, the most likely it is the episode has happened. This is only calculated once per event group (and is independent of any event score), and only added to the final score at the very last calculation, that happens two hours after the event group was created. Due to its importance and the fact that this is the only FIS that does not introduce any ambiguity, as it deals with the absolute number of people who have flagged an episode of incivility, this component was set to weigh the most on the event group score, 35%. The remaining FISs all relate to individual events and the sum of all FISs for all events will weigh 65% on the event score. Those FISs will be explained in the following points.

- FIS1 - Reputations of victim and offender – these variables are analysed against each other and the greater the disparity between reputations, the greater will be the impact on the likelihood of the event score, i.e. if the offender has a very bad reputation and the victim has a very good reputation it is more likely the episode has happened, than in a case where the offender has a very good reputation and the victim has a very bad one. This measure introduces some ambiguity, as even though it is more likely someone who has a good reputation won't flag someone else's violation of norms if it did not happen, it is not a certainty.

  Rules regarding FIS1 are of the kind:

  ```
  IF reputationVictim IS positive AND reputationOffender
  IS negative THEN score IS likely
  ```

- FIS2 - Previous times the offender has broken the same norm – this is the value of the offender's recidivism, i.e. how many times the offender has broken the same social norm before. This is an ambiguous variable, as even though it is more likely if someone has broken a norm multiple times before, they have broken it again, it can not be assumed that is an absolute truth.

- FIS3 - Number of historical interactions between victim and offender ("tit-for-tat") – this is the most ambiguous of the four components, as it tries to infer whether there are previous situations where these two people have flagged each other, and how frequent they are. It is ambiguous because if two people flag each other's behaviours frequently it might mean they dislike each other and want to use MACS as a tool to affect the other person, but it might simply mean these two people have more tendency to flag behaviours than others, and at the same time, have more tendency to violate norms. The higher the interaction between parties, the less impact it will have in the event score.

  Rules from FIS3 are of the kind:

  ```
  IF previousVictimOffender IS high AND previousOffenderVictim
  IS low THEN score IS neutral
  ```

  In the previous rule, "previousVictimOffender" represents the number of times the victim has flagged the offender in the past, and "previousOffenderVictim" represents the same thing, with inverted roles. So in the example the victim has flagged the offender many times before, but the offender hasn't flagged the victim frequently, in the past, so the likelihood for this being a situation of tit-for-tat is neutral, as it is difficult to infer whether or not there is an issue between the parties, based on these variables.

  Another example of a rule regarding this situation shows high values for both parties, with an evaluation of the event being valid of "unlikely", as this is likely to be some unresolved issues between both people, rather than the event being valid.

  ```
  IF previousVictimOffender IS high AND previousOffenderVictim
  IS high THEN score IS unlikely
  ```

Figure 5.7 is a more graphic overview of the whole process of calculation of an event group's score, based on **n** victims.

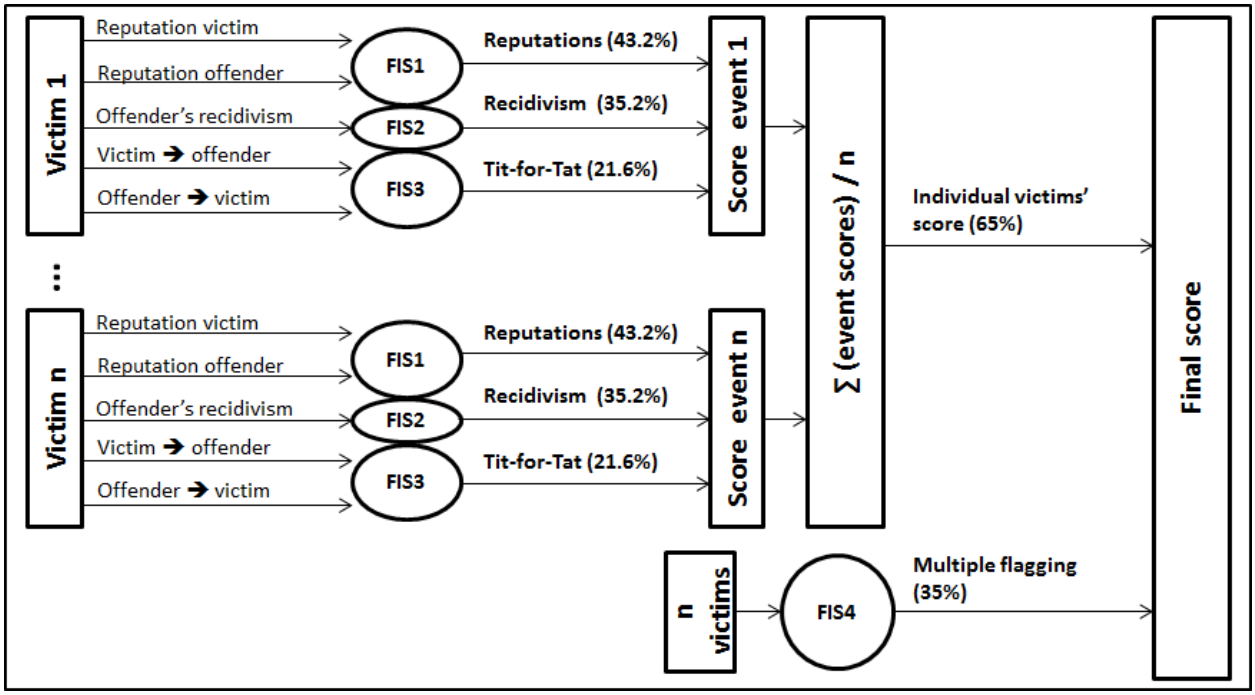

Figure 5.7: Fuzzy inference system for calculating the score of an event group in MACS.

Here, the first calculation of an event's score, for each of the victims, is presented on the further left area of the figure. Each of the sets for each victim, with FIS1 to FIS3, is what has been previously represented in the UML sequence diagram for the calculation of a partial score, in Figure 5.5. For each event (one victim, one offender, one broken social norm), the three fuzzy inference systems (FIS1, FIS2 and FIS3) calculate the event's score, which will then be combined with the other events' scores of the same event group. The sum of these events' scores will weigh 65% on the calculation of the final event group score. This will be combined, two hours later, with the result of the fuzzy inference system that deals with the number of victims that have flagged the same episode of incivility, FIS4. The latter weighs 35% on the final score. The final score represents the likelihood of the episode of incivility to have happened.

5.7 Database

MACS's database was created in MySQL. Figure 5.8 displays the simplified Entity-Relationship diagram of the database: it only contains table names and connections. The simplification allows for understanding the database structure without the bulkiness of field details.

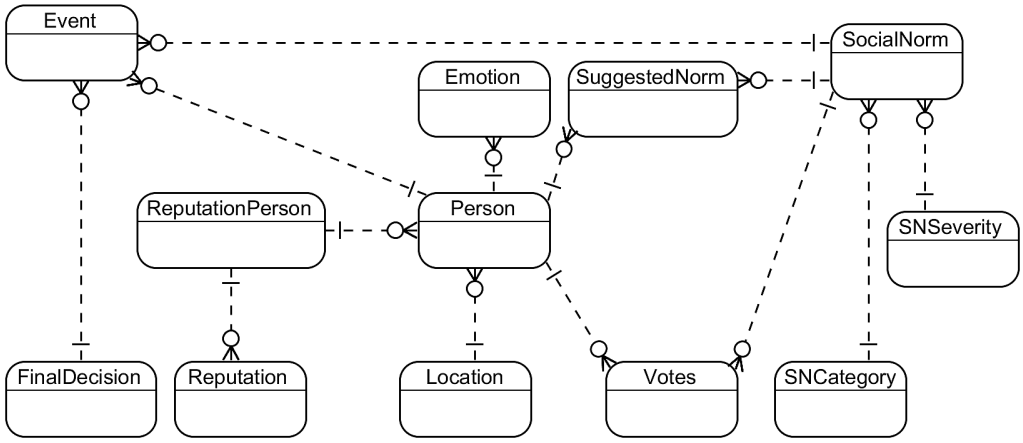

Figure 5.8: Simplified Entity-Relationship diagram of MACS database.

Each row on the *Event* table contains the data about an atomic event, with a single victim, a social norm and an offender. To avoid extra tables, the first event regarding an episode of incivility is given an *eventGroupId*, that is the same as the event's *id*. When new events are added, that refer to the same episode, they are given the same *eventGroupId* as that of the first event of the group. This simplifies the process of presenting data, as every episode has an event group, even if it is composed of only one event.

Whenever an event is created and the Reasoning module calculates its partial score, that score is stored in the *Event* table, updating the respective event's row. The *FinalDecision* table is the one containing the final score for each event group, hence only being updated two hours after the event was first flagged. This table also contains the factor by which an offender's reputation has been decreased, in cases where the event group is considered valid.

The *Person* table is connected to the *SocialNorm* table by two tables: *Votes* and *SuggestedNorm*. The former stores the votes on social norms from each person in the workplace. The latter stores all suggestions for new norms, made by people who share the workplace. The *SuggestedNorm* table is not necessarily connected to the *SocialNorm*

table. Only when a suggested norm (or list of suggested norms) is turned into a new social norm, is the new social norm's ID associated with all norms that originated it.

5.8 Scheduled tasks

Some tasks had to be automated in order for reputation, emotions and event-related actions to be completed.

As explained earlier, reputations are slightly increased daily to allow for people who have an exemplary behaviour to be rewarded, and for people who have broken the norms not to be stuck at a negative reputation forever. When MACS is first installed in a workplace, everyone's reputations are 0, neutral. Reputations range from -100 (unacceptable) to 100 (excellent). Every night, a scheduled task calls the Reputations module and it increases each person's reputation by 1, up to 100. This also means if someone has broken the norms in the past, they might still achieve an excellent reputation, if they don't break any more norms.

The affective interaction module is also called every night by a scheduled task, to reset the busy status on each person, in order to avoid people forgetting to toggle the busy switch off, and being on the busy state for days.

When an event is created its final score can't be immediately calculated, as it might have to be matched with other events that relate to the same incivility episode, at a later stage. Section 5.5.6 describes the full process of scoring an event group. As a first instance, the Reasoning module is called by the Event module as soon as each event is created. Every fifteen minutes a scheduled task checks for event groups that are on a stand-by status, waiting for a final score. If one or more event groups has been created over two hours earlier, the Reasoning module is invoked for the calculation of the final score for the event group.

There is another scheduled task running every fifteen minutes on MACS. This scheduled task works with the Event and Reputation modules. It looks for event groups where all victims have either forgiven the offender or ignored their apology, so they can be closed and the offender's reputation eventually increased. As explained in section 5.5.7, the offender's reputation is increased proportionally to the number of victims who have forgiven them.

5.9 Summary

This chapter has described MACS, the system we've developed to address the problem of incivility in shared workplaces.

After social norms are agreed on, between people who share a workplace, MACS allows for people to flag their co-worker's actions that violate the established social norms. This flagging is anonymous to avoid people not using MACS out of fear of retaliation or confrontation, or shyness.

There are three types of actors in the system – victim, offender and manager. The manager does not share the workplace or use MACS in its regular function, but has access to the administration and management interface. This interface allows the manager to have an overall idea of what's going on in the workplace: they can check open events, people's details and reputations, votes for or against norms, and suggestions of new norms. The victim and offender are both played by the same type of user, the regular user who shares the workplace with the remaining MACS's users who aren't managers. A user can be a victim and an offender at the same time, in different events.

Social norms are created with the agreement of everyone who needs to abide by them, and aren't necessarily static. Over time, people can vote positively or negatively for social norms, and can suggest new norms, meaning all social norms only exist while people believe they make sense.

MACS's architecture is composed of several modules, developed in PHP. These modules connect to an Interface developed in HTML, CSS, JavaScript and PHP (and presented in detail in Chapter 6), and a database handler (PHP and SQL). The Interface is the only way users can access MACS. The database handler is an interface layer between the remaining code and the database. The reasoning module adds intelligence to the system, with its algorithm containing several fuzzy inference systems to calculate a score for the probability of an episode of incivility being valid.

MACS is relatively easy to install in a new workplace, though requiring some customisation. Two very relevant parts of this customisation process are the creation of social norms, as it involves everyone's inputs; and the creation of each person's avatar, as people are asked to create their avatars to their image, and we expect that to create self-awareness.

Selection of social norms and customisation of avatars are key elements of MACS's interface design and implementation, as described in the next Chapter.

6

Interfaces

6.1 Introduction

MACS's interface and interaction were designed and implemented to provide the best UX possible. They include avatars that are built to the image of the users, and intended to keep the interface light and non-intrusive, while at the same time still creating self-awareness.

MACS has different interfaces for regular users – people who share the workplace MACS is being used in, and for a higher instance, henceforth called the "manager" – someone in the company who has access to information provided by MACS about the employees who use it, and has powers to intervene in case of an unresolved dispute.

MACS has had user evaluations over the course of its development, and its last version went through a more thorough UX user testing. It has also had a heuristic evaluation against Ostrom's principles for governing the commons.

All sketches, prototypes, final interfaces/interactions and guidelines for workplace design, along with the evaluations of our solution, will be presented in this chapter.

6.2 Design

In this section we will describe the interface creation process and present MACS's prototypes and final interface, from the initial paper sketches, to the final screen shots from the system.

In order to better understand the interface designs that are going to be presented next, we've created a map of the room depicting the user model and the role MACS plays in

the workplace. Each user accesses MACS on their computer, via a web browser, and that is represented by the arrows pointing from each person's computer to MACS's table of actions.

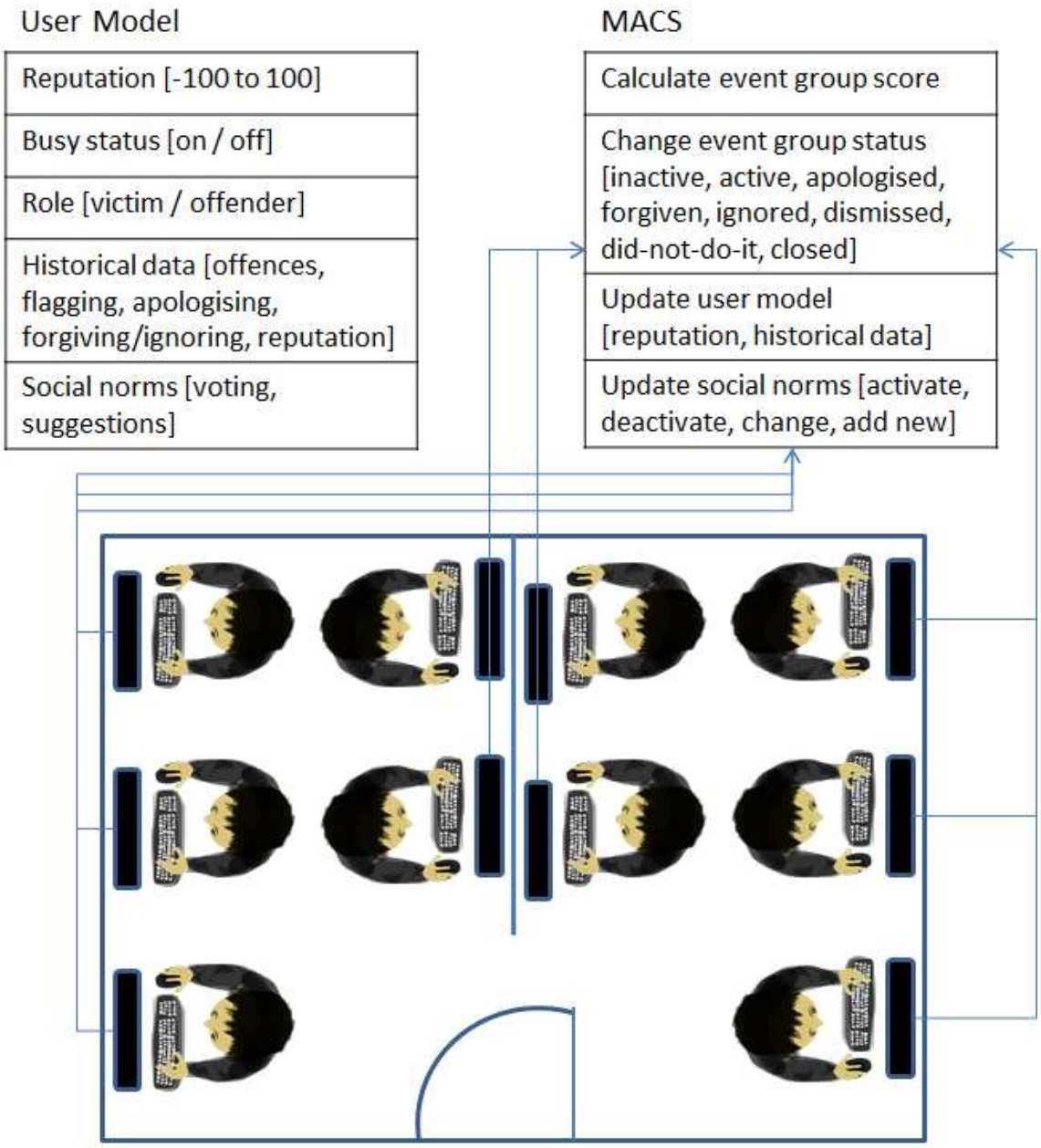

Figure 6.1: Map of the room depicting both the user model and the role MACS plays in the workplace.

6.2.1 Avatars

Given the choice between using avatars or real photos to represent the users, we opted for avatars. This decision was made for three main reasons:

- Avatars make the interface look lighter and more fun, which we believe is important, considering we're dealing with potentially delicate and heavy matters.
- Avatars seem less intrusive than photos, and as people are already putting themselves in a position where their co-workers are more aware of their actions, we believe they would be more willing to participate if they felt less exposed.
- Avatars, when created with similarity to the physical image of the person they are portraying, still create self-awareness [165, 166].

6.2.2 Paper sketches

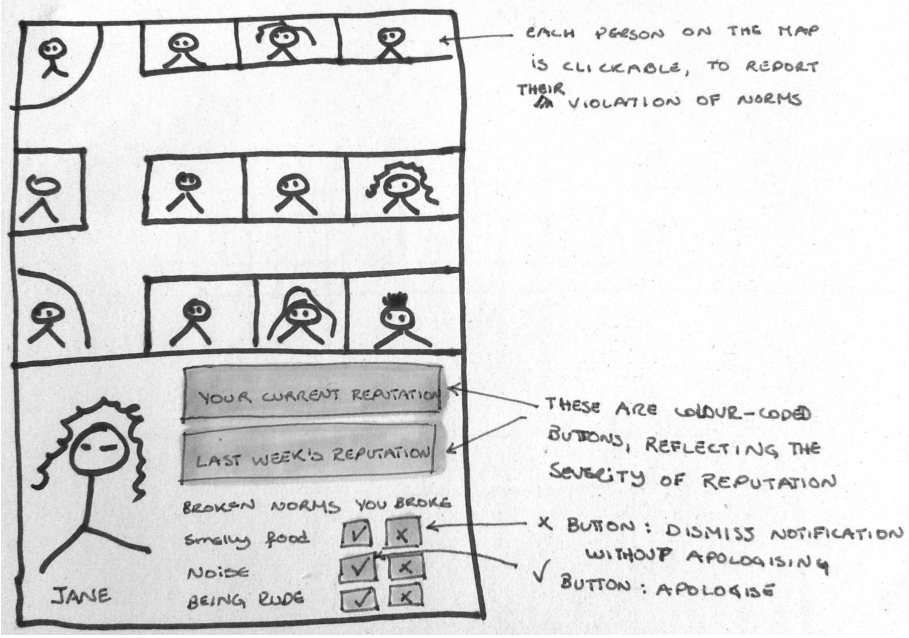

Figure 6.2: First sketch of MACS's interface.

The first prototypes of MACS's interface were simple paper sketches. They were used for practical reasons: sketches are relatively fast to produce, but still have the ability to

portray a good idea of what the envisioned interface will look like, and how users could interact with it.

Every person using MACS as a regular user, starts off by logging into their account. MACS has a web interface and is accessible on each person's Internet browser.

After logging in, the user would be taken to the screen sketched on figure 6.2. The idea on this sketch is that the top area of the screen presents a map of the room, with the avatars of each employee placed over their respective desks. By clicking on avatars, incivilities can be reported. Below there is the avatar of the logged user and data about their current and last week's reputation. These were envisioned as colour-coded bars that reflect the status of the reputation, from unacceptable (red) to excellent (green). Below the reputation information, are the open events, listed as a set of broken norms with an "Apologise" and a "Dismiss" buttons ahead, where the user could either apologise for having broken the norms, of dismiss the information.

There was also a sketch for the victim's view on the home screen. These initial sketches were presented to colleagues, and with their feedback, they were later on refined into PowerPoint low-fidelity prototypes. All concepts present in the paper sketches were validated by colleagues and therefore the PowerPoint prototypes depicted the same ideas, with some added visual enhancements, like colour and avatars.

6.2.3 Low-fidelity prototypes

Low-fidelity prototypes were created in PowerPoint for both the regular users' interface and the manager's interface. PowerPoint was chosen for practical reasons. It was available, easy to use and provided another layer to a prototype – colour.

6.2.3.1 Regular users' interface low-fi prototypes

Figures 6.3 and 6.4 show the employee low-fidelity prototypes for the initial screen for where a person is a victim or an offender, respectively. Figure 6.4 is the low-fi prototype of the sketch presented in 6.2.

Figure 6.3 shows Person X logged in and his avatar pictured at the bottom left of the screen. Person X has flagged two different actions as inappropriate and can now read the apology or explanation the offenders wrote. He can click the green check box and increase the reputation of the offender, or discard the apology/explanation by clicking on the red button with a cross.

Figure 6.3: Low-fidelity prototype of the victim's starting screen.

He can also see the map of the room, with his co-workers' avatars surrounded by a colour that represents their current reputation. He can click on an avatar to report that person's violation of a social norm. In this screen he can also see his current reputation and the reputation he had the week before, so he can be aware of his evolution. In this particular case, his reputation is good in both weeks, hence the green colour.

The employee's interface also has three additional tabs: "social norms", "history" and "flag behaviour". The "social norms" screen displays the current social norms of the workplace. The person can check the social norms, but cannot edit, add or delete them. The "history" screen shows all the episodes involving the current person, either cases where they have flagged inappropriate behaviour, or cases where someone else reported their behaviour as inappropriate. Finally the "flag behaviour" screen is another path to report a faulty action.

Figure 6.4 shows the offender's perspective on the regular user's interface. As in Figure 6.3, in Figure 6.4 Person X can see the map of the room and flag a violation of the social norms, and she can see her current reputation.

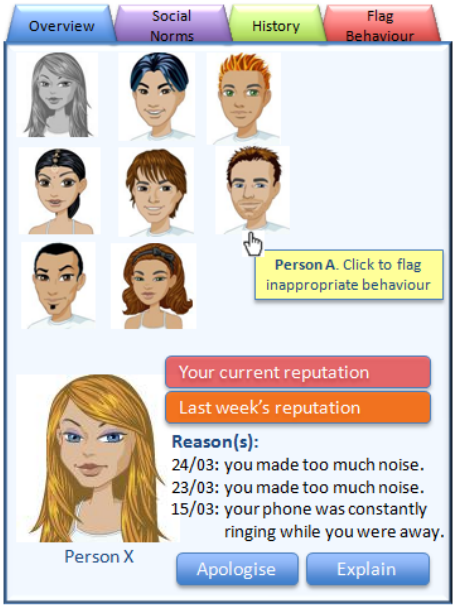

Figure 6.4: Low-fidelity prototype of the offender's starting interface.

At the moment her current reputation is colour-coded red, which means it is in a critical negative level. The week before (last week's reputation) it is colour-coded orange, which means her behaviour has worsened. She can see a list of events where she has broken the norms, but she can't see who has flagged them. She can click the button "Apologise" or the button "Explain" and either send an apology, or write an explanation for her behaviour and send it to the victim(s). If the victim(s) decide to change her reputation, she can, later on, read that information in the system.

6.2.3.2 Manager's interface low-fi prototype

The manager interface is presented in Figure 6.5. In the first screen ("overview"), shown in the figure, there is an overview of the current status of the workplace. This information is presented in a map of the workplace, where each of the people who share the workplace are represented by an avatar. The area around the avatar is colour-coded, according to the person's level of compliance with the social norms. This colour codification is based on the reasoning made by the system about each element's compliance with the norms and should vary throughout time.

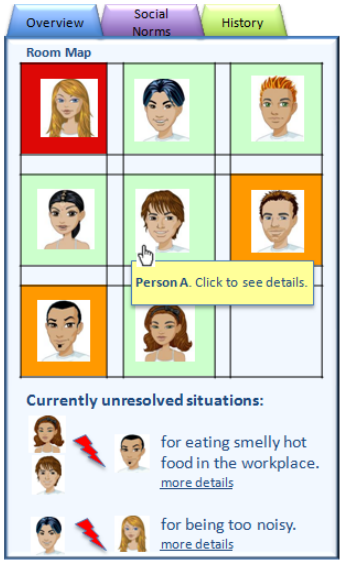

Figure 6.5: Low-fidelity prototype of the manager's admin screen.

Additionally this screen shows the current unresolved situations, by showing the avatars of the victims on the left side and the offender on the right side, and the description of the reason why the victims flagged a violation of norms. These are cases where an event has been created, but nothing yet has been done to try to fix the situation, i.e., either the offender hasn't apologised or provided an explanation of their actions, or the victim(s) haven't forgiven the offender. If the manager wants to know detailed information about a person, they can click on that person's avatar and another screen will be displayed. This screen has detailed information about the person, including past situations where the person has been involved either as a victim or as an offender.

The manager interface has two more tabs – "social norms" and "history" – where they can, respectively, manage the social norms, by editing, adding, or deleting social norms, and read historical information about the workplace.

6.2.4 Final interface

While iteratively developing and testing MACS, it became evident that some of the initial interface ideas were not viable or the best ways to achieve MACS's goals. So despite the fact that most of the concepts from the low-fidelity prototypes were kept in the final interface, some new items and interactions were introduced and others changed or removed.

In this subsection we will present figures of the most relevant interfaces, and explain others, when important to understand sequences of events. All figures on this section are screen shots from MACS, not prototypes.

MACS's interface was designed with HTML, CSS and JavaScript.

Subsections 6.2.4.1 and 6.2.4.2 present the interfaces for regular users and managers, respectively.

6.2.4.1 Regular users' interfaces

The victim and offender roles are played by the same type of user, so it became clear those two interfaces had to be more harmoniously blended into each other. A user can be a victim in some events and an offender in others and all that has impact over what the final interface should look like.

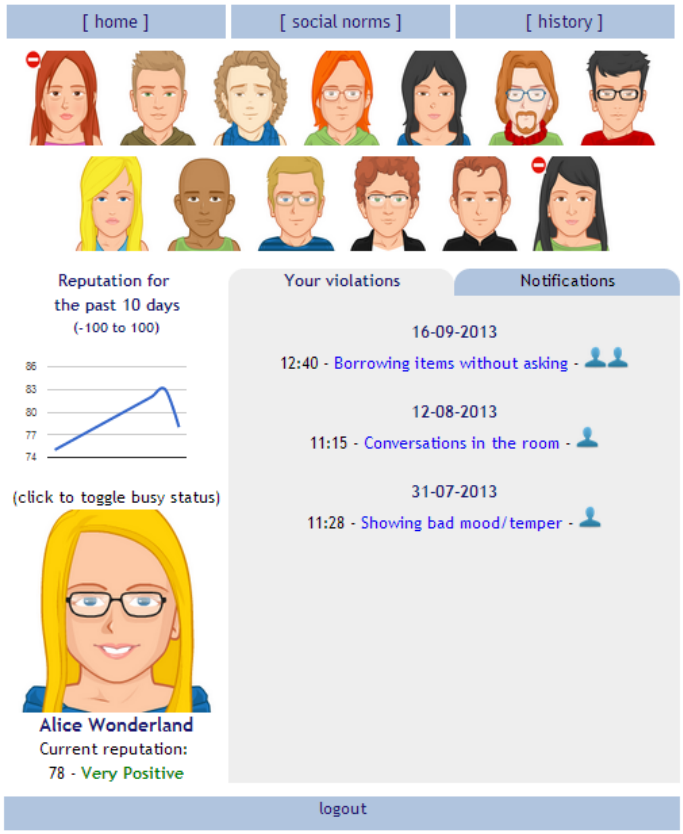

Figure 6.6: Start screen for a regular user, after successful login.

Figure 6.6 depicts the first screen displayed for a user, right after a successful login to

MACS. The navigation bar, on top, and the footer bar, at the bottom of the screen, are constant throughout MACS. The navigation bar provides direct access to the home screen presented in Figure 6.6, the social norms screen (shown in Figure 6.9, and explained later on) and the historical information about events where the logged user has been involved in, as an offender. The footer bar allows for a user to logout from MACS.

Right below the navigation bar, is the set of avatars representing all the people the logged used shares the workplace with. By hovering on each of the avatars the text "Flag *person's name*'s violation of norms" shows up, where *person's name* is replaced by the chosen person's name. By clicking on an avatar, the user is taken to the flagging screen, where they can create a new event, by flagging a violation of norms by the person they chose.

At the bottom left area of the screen there are two different items regarding the logged user: Their current reputation and its evolution graph for the previous 10 days, and their avatar and name.

On the list of people at the top of the screen, some people have a "forbidden" sign next to their avatar. People who have this sign have requested not to be interrupted. As shown on Figure 6.7, this "busy" status can be toggled on and off by the logged user, by clicking on their own avatar to swap the current status. Every night all users' "busy" status is cleared, as explained on Section 5.4.5.

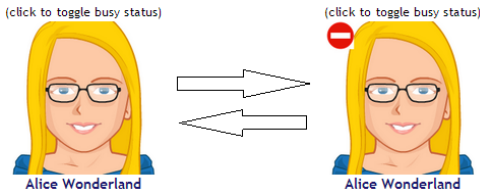

Figure 6.7: By clicking on their own avatar, users can toggle their busy status on/off.

The right area of the screen, below the list of avatars, always starts with the "Your Violations" tab selected, and presents all open events where the user is an offender, ordered by date, from the most recent to the most ancient. The user can see the time and date of the offence, the social norm they have allegedly broken and how many people have flagged each event, but not specifically who has flagged it. If the event text is black, this means they have apologised. If it is blue, it is a link and they can click on it to go to the event

details screen, where they can apologise and explain what happened, or say they did not do what they are being accused of.

If they have notifications from MACS, the "Notifications" tab's text is printed in dark-red, with a counter of open notifications in brackets. Otherwise, the tab's text has the same colour as the "Your violations" tab.

As said before, not all screens will be presented in a figure, so now follow explanations for the ones that are relevant, but not presented.

The "Event" screen, i.e. flagging a violation of norms screen – This screen is presented when a user clicks on an avatar to flag someone's violation of the norms. It displays the offender's name, a drop down list of available social norms, and a calendar asking for time and date of the occurrence. There is also a notes box, that can be filled with any additional information about this event.

The "Apologise" screen – This screen opens when a user clicks on an event. It presents the details of the event – date, social norm, social norm description and number of people who have flagged the violation of norms – an "apologise", an "I didn't do it" and a "Back" buttons, and a free text box where the user can write an explanation.

Figure 6.8 shows a zoomed-in extract of the "Notifications" screen. This screen is accessible by clicking on the "Notifications" tab on the home screen (see Figure 6.6). These notifications are either about open events where the user was the victim, or information about the closing of events where the user has apologised for breaking a norm. Notifications are listed by update date. Notifications about events where someone has apologised show the date of apology and respective apologies/explanations. The "Accept" and "Ignore" links are self-explanatory: If the user wants to forgive the offender and improve their reputation, they should click "Accept". Otherwise, they should press "Ignore".

Another core function of MACS is to keep the users informed about the social norms they must abide by. Besides being able to check the norms at all times, users must also be able to vote for them, positively or negatively, and to suggest new norms.

Figure 6.9 displays the "Social Norms" screen. Here all norms are presented, ordered by severity level, from the most to the least critical. Each norm is printed in the colour code that reflects its severity. Red means the norm is very critical, orangey-red means critical, orange means average, and finally yellow means minor. In this case, there aren't any minor severity norms to be displayed. In front of each norm, in square brackets, is its category. Categories are "noise", "privacy" "food", "environment", "politeness" and

Figure 6.8: Extract from the "Notifications" screen for a regular user.

"borrowing items". Below each norm is its description. And finally by each norm are an approve (thumbs up) and a disapprove (thumbs down) buttons, which can be used to vote positively, or negatively, respectively, for the norm.

At the bottom of the list of norms is the suggestion box, where the user may suggest a new norm for their workplace. The manager has access to suggested norms, and if they want to turn a suggested norm into an active norm, they must suggest it to every user, and only create the norm if at least the majority of people agrees with it.

6.2.4.2 Manager's interface

The manager is, as explained in section 5.4.2, someone who has some sort of management privileges over the users sharing the workplace MACS is installed in.

On login, the manager is taken to the "Open Events" screen, presented in Figure 6.10. This screen, as the title indicates, displays all open events for the given workplace. As it happened for the regular user's interface, the manager's interface also has a constant

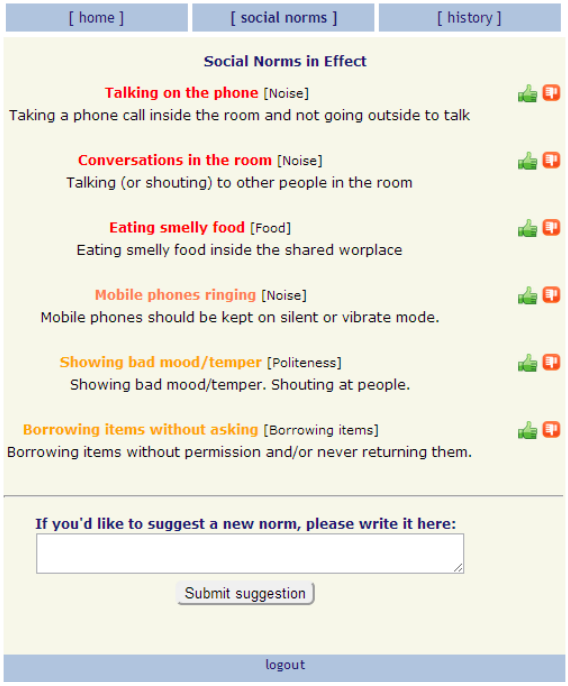

Figure 6.9: Social Norms screen, where the user can check the social social norms, vote for them, and suggest new norms.

navigation bar on top and a footer bar for logging out, at the bottom. The navigation bar provides fast access to the "Home" screen, which shows the open events and is presented in the current figure; the "Social Norms" screen, which will be explained below and displayed in Figure 6.15; and the "People" screen, also explained below, with Figure 6.13.

Open events are all events that require action from either the offender (to apologise and explain what happened) or the victim(s) (to forgive the offender or ignore their apology). Each event is presented on a line, which shows, in order, the time of the offence, the avatar of the offender, the broken social norm (with "apologised" in brackets, if the offender has apologised for this event), and the avatars of the victims. All avatars throughout the manager's interface are clickable to display the details of the person they represent. This will be explained below, and presented in Figures 6.13 and 6.14. The broken social norm is also clickable, to open a new screen with the details of the current event. This screen is presented in Figure 6.12 and explained later in this subsection.

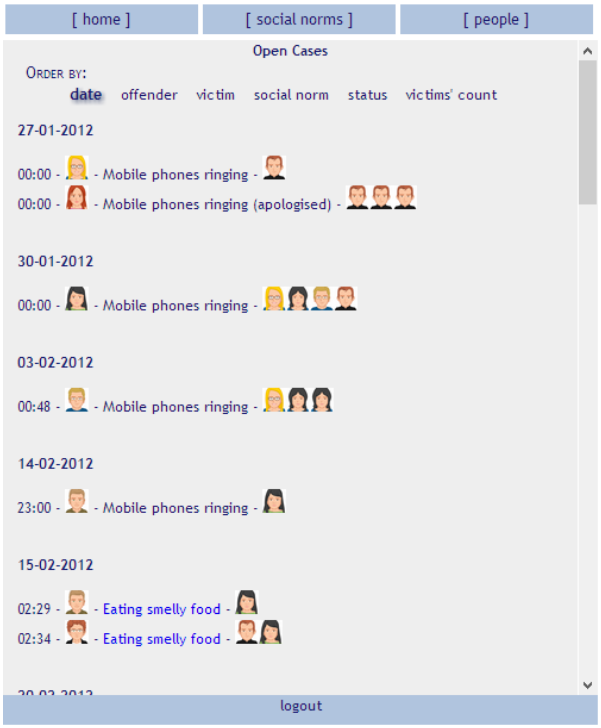

Figure 6.10: Starting screen for the manager's interface, presenting all open events, ordered by date.

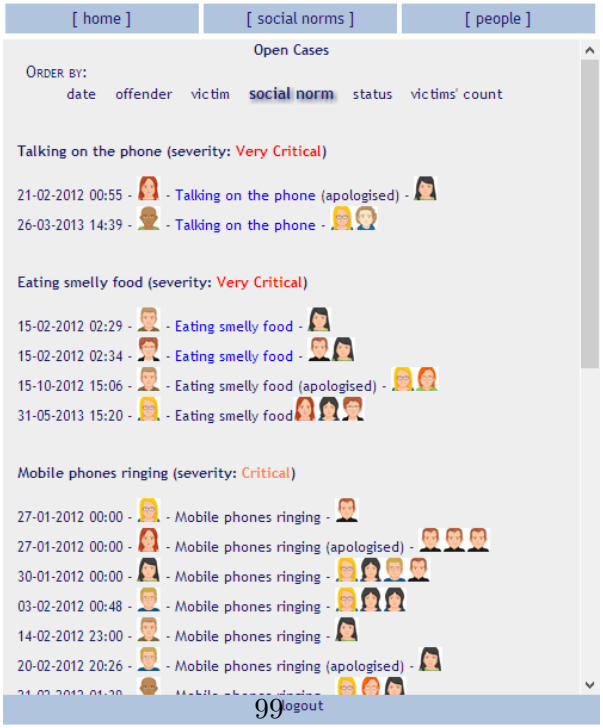

Figure 6.11: Starting screen for the manager's interface, presenting all open events, ordered by social norm.

The default order by which open events are presented is date, but the manager can change the order field, so open events are ordered by offender, victim, social norm, status (either waiting for an offender's or victims' action), and victims' count, i.e. the number of people who have flagged the same event. Figure 6.11 shows the list of events ordered by social norm. This is an important view as it provides an overview about which social norms are being violated the most, at a given time.

Figure 6.12 is the interface that opens when the manager clicks on an open event on the "Open events" screen, in Figure 6.10).

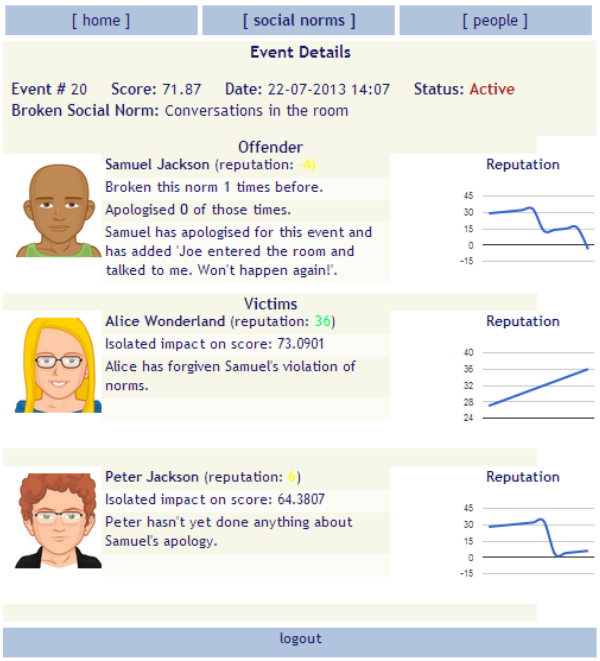

Figure 6.12: Manager's view of the details of an open event.

This screen starts by presenting the general event details, i.e. the event ID, its score, the date of the occurrence, the event's status, which can be *Active*, *Waiting for Score*, or *Closed*, and the broken social norm.

Next it displays the offender's details: Their avatar, full name, reputation and reputation evolution graph for the previous 10 days, the amount of time they have broken the same norm, the number of times they have apologised for it, and, in case they have apologised for the current event, their apology.

The reputation varies between -100 and 100 and its value is colour-coded from red to green (from unacceptable to excellent), to reflect the current reputation's severity. In Figure 6.12 only the first victim has a regular reputation progression, meaning she hasn't broken the norms in the past 10 days.

The offender's graph shows he has broken a norm five days before and he either hasn't apologised, or the victims haven't forgiven him. Otherwise, the reputation would have had a sharper increase than the one displayed. The increase after that violation of norms is just the daily increase in reputation. The current event has taken this offender's reputation below 0, but it is still in the neutral zone. Reputations might still be improved once an event is closed, i.e. both victims have either forgiven the offender or ignored their apology. In this case, since one of the victims has already forgiven him, his reputation will be increased, even if the other victim ignores his apology, but only by half of what it might be increased, in case the other victim also forgives him.

Below the offender's details are the victim(s)' details. Each victim's details include their avatar, full name, colour-coded reputation and reputation evolution graph for the previous 10 days, the isolated impact in the score, i.e. how much the factors relating only the offender and this victim affect the final score. This means the amount of people flagging the same violation of norms isn't accounted for when calculating this partial score. Finally the action (or lack of) taken by this victim regarding this event is presented. It can either be "*Alice* hasn't yet done anything about *Samuel*'s apology", "*Alice* has ignored *Samuel*'s apology" or "*Alice* has forgiven *Samuel*'s violation of norms".

When clicked, every one of the avatars throughout all manager views open the details view of the person represented by that avatar.

Figure 6.13 shows all the information MACS has about a person. All users' avatars are displayed on top, so the manager can toggle easily between people. Below the avatars are the details of the chosen person.

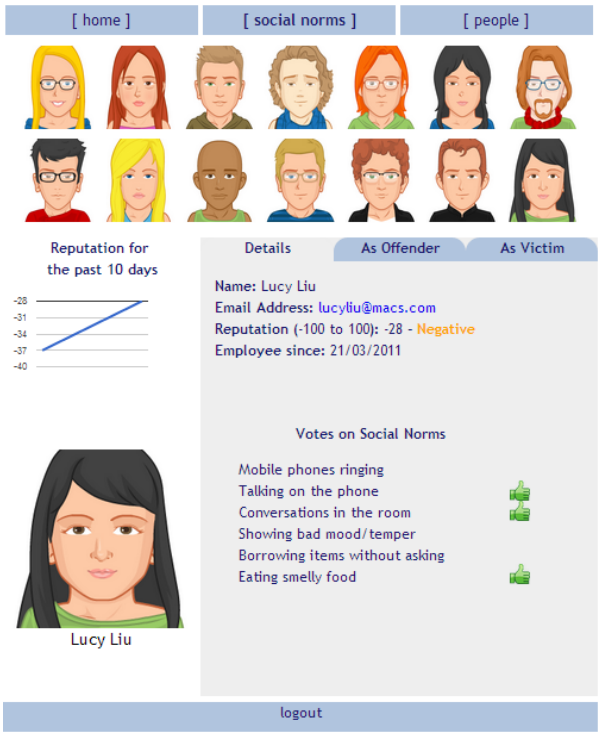

Figure 6.13: Manager's view of the details of a chosen person.

Similarly to what happened on the start screen for regular users, the left bottom side of the manager's view of the person's details shows the selected user's reputation and its evolution graph for the previous 10 days, the user's avatar and their name. The mid-right side section, below the avatars, has three tabs: "Details", "As Offender" and "As Victim". The "Details" tab, active in the figure, shows the person's full name, email address, reputation and reputation description (colour-coded to reflect the reputation's severity), and start date as an employee at the company. Below are the selected person's votes in each of the active social norms. These votes are represented by a thumbs-up green icon and a thumbs-down red icon, whether the vote has been positive or negative, respectively.

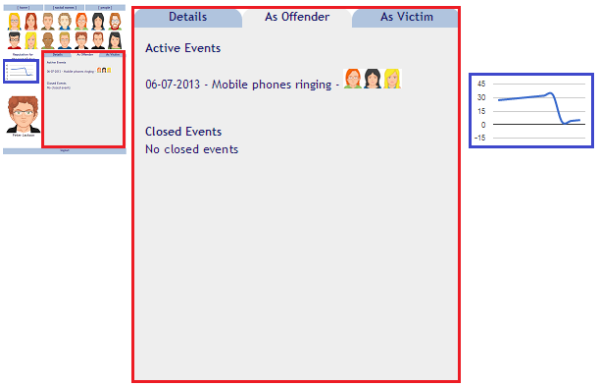

Figure 6.14: "As offender" tab on the person details' view for the selected person. This figure has two magnified sections: the reputation progression graph (blue frame) and the list of events where the user was the offender (red frame).

The user's overview as an offender is displayed in Figure 6.14. This figure has two magnified sections: the central area (surrounded by red), and the reputation's evolution graph (surrounded by blue).

The central area contains the list of events where the user is the offender. It displays both the active and closed events. This means the manager can check the details of previous offences of the same offender (by clicking on the event, the event details will be displayed), even if the event has been closed. This might not be necessary most of the times, but might be important to understand odd episodes where, e.g., the offender's apology has been ignored by all victims.

The reputation graph is highlighted as it is interesting to see the reflection of the event on the offender's reputation. There is an active event and the offender hasn't apologised. This means his reputation has been decreased when he broke the norms, and not yet changed by factors relating to this particular event. There is a slight increase in the reputation value, but that's due to a daily increase in reputations – every day each person's reputation is increased by 1. If the offender apologises and all victims forgive him, his reputation will be almost fully restored. If only one or two of the three people (in this particular case) forgive him, the reputation will be increased by 1/3 or 2/3 of the possible increase value, respectively.

The view "As victim" won't be presented here, as it is very similar as the "As offender"

view, with the only difference being the selected user is now one of the victims of an event, rather than the offender.

Figure 6.15: Social norms interface in the manager's view.

Figure 6.15 displays the manager's view of social norms. Whereas regular users can only read, vote for, and suggest new social norms, the manager has a wider range of options regarding the norms. In this screen the norms are presented ordered by their severity level. The title of the norm is printed in the colour that reflects its severity – red for very critical, orangey-red for critical, orange for medium and yellow for minor. In front of the title are counters for positive and negative votes, respectively. Then follows a description of the norm. And finally below it, are links for editing and disabling the norms. If a norm is disabled, it will be presented below all active norms, with an option to enable it.

On the top left of the "Social Norms" screen are a button to create a new norm, and a button to check the suggested norms. Next to this button is a counter of the number of

suggested norms.

6.3 Guidelines for workplace design

Throughout the course of this project we've been studying interactions between people who need to share open spaces and tools, which has led to the creation of the following guidelines for workplace design:

Establishing clear and congruent social norms

Even though the literature review has shown the importance of the definition of norms that are visible and known by all people who must abide by them, the questionnaire has shown that most companies do not establish workplace norms, or they are not clearly presented to the workers (only 24% of the people mentioned they knew of their workplace norms).

Regardless of how loose the office environment might be, having established social norms that are clear and congruent is fundamental to avoid situations of incivility, caused, mostly, by people not being aware of how annoying or upsetting their behaviours might be to their co-workers.

Having social norms agreed on between everyone who must abide by them, and individual to the workplace they belong to

Social norms are context-bound, meaning what is considered to be an uncivil behaviour in a workplace, isn't necessarily seen the same way, at a different workplace. Social norms should reflect the needs of the people who will abide by them, and therefore they should be created by them, and not by some higher or external instance.

Always having the social norms visible for everyone

The questionnaire has shown how even in companies that have expressed social norms, most of the times it is difficult to consult them. Over half of the people whose companies have social norms, do not know how or where to go to in order to read them.

Even in cases where norms are sent by email or delivered to workers on a welcome pack, people are busy and receive and process various bits of information daily. This means, unless social norms are visibly stated somewhere permanent, they might be easily

overlooked. Therefore, we believe one way of encouraging norm compliance, is to have norms clearly stated, easily accessed and visible for everyone who must abide by them.

Allowing for participatory adaption of social norms over time

Some circumstances might cause the social norms to change over time: Some norms might become obsolete and some norms might have to be added to the existing set of social norms. As well as it is important that social norms are determined by those who will abide by them, it is also fundamental that those affected by rules are given the right to participate in modifying them [122].

Providing ways for people to solve situations of incivility amongst themselves, without the need for micro-managing

Incivility is considered to be a minor workplace deviance, which means most companies will do nothing to address it. However, workplace incivility causes work-related disturbances, victims' mental and physical health problems and personal life repercussions.

The low intensity and ambiguity of intentions that are characteristic to incivility, make it the ideal candidate to being solved, without resourcing to managers. Many times incivility is caused by the instigator's lack of self-awareness, rather than malice, which might mean they are willing to change their behaviours, if made aware they are upsetting their co-workers.

Making people aware of the graduated sanctions applicable for repeated violation of norms

The questionnaire has provided some insight into the way companies sanction their workers for breaking norms. Only 11.2% of the people have stated that their company has established norms and they know what the sanctions are for breaking them.

The lowest the risk of repercussions is, the highest the likelihood of norms being broken is. Whereas some people might break the norms motivated by lack of self-awareness, or ignorance of the rules, others might break them because they do not care if they affect someone else. If there are no known sanctions associated with the violation of social norms, people belonging to the latter group, won't have anything stopping them from breaking the rules.

It is, therefore, important, that along with the definition of social norms, there is a definition of graduated sanctions associated with breaking them, and everyone is made aware of those sanctions. Graduated sanctions progress incrementally based on the severity of the violations, and recidivism.

Enforcing graduated sanctioning for repeated violation of norms

In parallel with the situation where defining norms does not mean people will follow them, defining graduated sanctions for norms, does not necessarily mean sanctions will be enforced, in case of norm violation. It is, however, important, that the stated sanctions are put into action, to avoid feelings of impunity and injustice, and to discourage people from breaking the norms.

Providing positive feedback for people who consistently abide by the social norms

As well as it is important to notify people when they break the social norms, and to sanction them, when they persistently break them, it is important that people who have consistent civil behaviours receive some positive feedback, so they'll know their good behaviour is acknowledged and appreciated.

6.4 Summary

This chapter has presented the stages of construction of MACS's interface and interaction, from initial paper sketches and low-fidelity PowerPoint prototypes, to a full-functional HTML / CSS / JavaScript interface.

People are represented by avatars, instead of photos. This was a design decision, based on the premise avatars, when created with similarity to the physical image of the person they are portraying, still create self-awareness [165, 166]. Additionally, avatars seem more fun and less intrusive than photos, and as people are already putting themselves in a position where their co-workers are more aware of their actions, we believe they would be more willing to participate if they felt less exposed.

The final version interface is made of several interactive screens for the regular users – people who share the open-space workplace, and for the manager – person in charge of

looking after the remaining users. The actors have been explained in Section 5.4.2. The interface was designed with UX in mind, and attempts to be intuitive and simple to use.

MACS went through a UX user study, which has validated the intended work-flow, and user interfaces to support the work-flow's smooth passage. The UX user study's findings have led to a few simple changes. Even though some features weren't as intuitive as we'd expected while designing them, the overall opinion about using MACS was that it was easy to understand and use, and most of the suggested changes concerned providing more hints to a first-time user, rather than changing interactions or functionality. This meant changes were quick and easy to implement.

Based on all the previous work and MACS's evaluation, guidelines for workplace design have been created and presented on this chapter. These guidelines take into consideration the need for social norms being determined and updated by people who will abide by them, the requirement for established sanctions for violation of social norms, and the need for an internal incivility reparation mechanism.

Finally our solution, composed of MACS and the guidelines for workplace design, has had a heuristic evaluation against Ostrom's principles for managing a commons. From this evaluation we've concluded the solution follows seven of the eight principles, with the remaining one not being applicable to this case, as it refers to a whole company, rather than a shared workplace.

7

Evaluation

7.1 Introduction

The previous two chapters have described our solution: MACS, its architecture and interface, and proposed guidelines for workplace design. This chapter will present the evaluations conducted to validate MACS's work-flow, UX, and effect on real-life workplaces, as well as the solution's evaluation against Ostrom's principles.

Through the course of its development MACS has had user evaluations that led to the refinement of the interface into its final version. The final product went through a more thorough UX user testing, which will be presented in the next section.

MACS and our proposed guidelines for workplace design were based in Ostrom's principles for governing a commons [122] and therefore we've conducted a heuristic evaluation of MACS and the guidelines against Ostrom's principles. This evaluation will be described in 7.3.

Finally we conducted two field trials to assess the usage and impact of MACS on real-life workplace settings. These included observations, meetings to determine social norms for the workplaces, before- and after-MACS questionnaires and people using MACS for two weeks in their workplaces. Both field trials were done in academic environments, where the people sharing a workplace were PhD students and post-doctoral researchers. The first field trial was done at Universidade do Porto, in Portugal and the second one was done at a Robotics Lab at Imperial College London, in the United Kingdom. Firstly we will describe each of these field trials separately and at the end we will discuss similarities and differences between them. The field trials are described in 7.4.

7.2 UX evaluation

MACS's UX has been evaluated throughout its development, as a way of getting feedback for further developments. The initial evaluations were made by colleagues. They were presented with the low-fidelity prototypes of the "home" screen (described on Section 6.2.3) and a working version of MACS was constructed, based on their feedback.

MACS's final version had a more in-depth UX user testing. 6 people were used for the study, and they all have different sorts of jobs, from accounting to working in a biology lab. The common ground they share is they all need to share workspaces and/or equipment in their everyday work life.

We chose to use 6 people for this UX study, as on qualitative studies, such as this one, 6 people will detect about 90% of the UX issues with a system. As the UX tests go on, each additional subject will have some overlapping actions with the previous subjects, so by the time we get to the 6th person, most of the actions overlap what has been learnt before [119].

7.2.1 UX testing methodology

The subjects were given a script to follow on MACS. Their faces were filmed by a webcam while they were going through the script and thinking-aloud. The evaluator was in the room and took notes as the test went on. The screen could not be filmed at the same time, for lack of resources. Filming started when the testing started, i.e., when the subjects were given the script, and ended when, after having completed the whole script, subjects were asked if there was anything they would like to ask or suggest and answered that question.

Before the subjects started the test they were given a briefing about what MACS is intended to achieve; how social norms in MACS have to be defined by people who share the workplace, rather than management; and what the situation they are trying to test is, i.e. they were told every person in the workplace is represented by an avatar, and to imagine they share a workplace with the thirteen people presented in the MACS test version.

The script presented fifteen instructions or questions that were meant to test all of MACS's features, without coaching subjects into achieving their goals. So rather than saying, e.g., "Please click on *social norms* to view all the norms you should abide by", it asked "What are the social norms in your workplace?".

The test did not have a fixed end time, so subjects would not feel pressured. Four of the subjects completed the test in around twelve minutes and one subject completed it in twenty minutes.

The videos were later on analysed in order to review both facial expressions and comments subjects were making while going through the script, as they had been asked to think-aloud as they were doing so. That, along with the notes taken during the test, has led to a list of findings for each of the sections of the test. Those findings will be presented in the following sections.

7.2.2 Flagging a co-worker's violation of norms

The instruction on the script to assess how easy this action is was "Flag a co-worker's violation of a social norm.".

Even though when going through this step, four of the test subjects immediately clicked on someone's avatar to flag them, two people did not understand straight away what they had to do. They eventually figured out how to do it, one of them within a minute, and after being hinted about paying attention to the text that hovers over the images; the other one, with no hints, within twenty seconds.

While after knowing how to do it, it is clear that in order to flag a co-worker's violation of a norm people have to click on that person's avatar and fill in the details about the event, that is not always obvious on a first interaction with MACS. One of the test subjects who didn't immediately understand how to do it, has said, about this feature: "It's just like Facebook: After you know how to use it, it's very easy to do it".

Of course, ideally, people wouldn't have to be in a state of initial confusion, so we came up with a simple solution. We wouldn't want to clutter the interface with unnecessary information. We also felt when users know how to use something, having needless hints on how to use it might be annoying, rather than helpful. So the answer for this particular situation was to present a textual hint over the avatars area, explaining how to flag someone's behaviour, exclusively for first-time users. After a user flags someone's violation of norms, or from the second login on, this hint isn't displayed any more. Figure 7.1 shows the changed screen.

Figure 7.1: Change for first time users: Over the list of avatars, there is a help line instructing the user how to flag someone's violation of norms.

7.2.3 Reputations

The questions on the script regarding reputations were "What's your current reputation?", "How has your reputation evolved in the past few days?" and "Has your reputation changed? Can you tell why?"

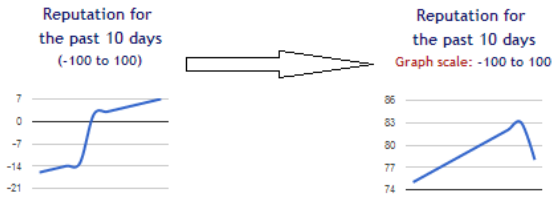

Figure 7.2: Change in the Reputation Evolution Graph's label for better readability.

During the test, the subject's reputation changes to a lower value, as someone reports their violation of a norm, and then, as they apologise and the victim forgives them, their reputation goes back up.

All test subjects managed to readily identify their current reputation and explain changes in the reputation's variation, so it was obvious for them that their reputation had decreased when they broke the norms, and as they'd apologised and someone else had accepted their apology, their reputation had been almost fully restored.

As for the evolution of their reputation for the past few days, the existing graph caused some confusion. Everyone could tell the trend of their reputation, but two of the subjects didn't realise -100 to 100 was simply the graph's scale, and not the variation in their own

reputation, and only after being hinted about the graph, did they manage to say what the real values in their reputations' evolution were.

The graph used is a Google Charts solution, and therefore not very easy to manipulate. So in order to solve this problem, with the existing tools, we changed the labelling of the scale from "(-100 to 100)" to "Graph scale: -100 to 100", as seen in Figure 7.2. As future work, perhaps creating a graph from scratch would present a better solution.

7.2.4 Apologising for a violation of the social norms

The script asked "Can you tell what the details of an open event (where you've broken the social norms) are?", "What are your options regarding that event?" and "Apologise for having broken the social norms.".

There was some confusion regarding accessing the details page of an open event, because by the time subjects got to this question, they were at the "history" section, where they'd noticed an open event, and had tried to click it. After failing to click on an open event on "history", all subjects clicked the "home" link and found the link to an open event on the "Your violations" tab.

Checking the options they had, regarding an open event where they'd broken the norms, and apologising for having broken the norms were straightforward actions for all test subjects.

Based on the initial trial to click on open events in the "history" section, a change has been made so that all open events are clickable links for the events' details page. Other sections of MACS have different routes to access the same feature, as we made a point of building MACS under those interaction premises. In this particular case, this wasn't available out of forgetfulness, and not because we thought it wasn't relevant.

7.2.5 Notifications and forgiveness

The instruction regarding notifications and forgiveness is "Forgive or ignore someone's apology.". The "Notifications" tab, which is coloured dark-blue and non-clickable when there aren't any notifications, turns dark-red and clickable, and has a counter of the number of available notifications, when notifications are available.

All test subjects noticed the change on the interface every time the "Notifications" tab became enabled, and clicked on it. So when the notification about someone having

apologised for breaking the norms on an event they'd flagged came up, they had no problems in clicking the "Notifications" tab, reading the apology, and accepting or ignoring it.

The same way, every time there was a notification about someone having forgiven them for an event where they had broken the norms, all subjects managed to read it and understand the change on their own reputation based on the whole process of breaking the norms, apologising and being forgiven.

It became very clear the way the "Notifications" tab behaves, going from non-clickable dark-blue to clickable dark-red with a counter, immediately captures the users' attentions, as they'd notice that change as soon as it happened, and they'd immediately click on it.

7.2.6 Social norms

The questions regarding social norms were "What are the social norms in your workplace?", "What would you do if you didn't agree with a social norm?", "What would you do if you thought a particular social norm was great?" and "What would you do if you wanted to suggest a new social norm?".

All test subjects could easily identify the social norms, vote positively or negatively for the norms they like or dislike, respectively, and suggest new norms, so this section has not been changed.

7.2.7 "Busy" status

There was one simple instruction regarding this item, which was "Change your busy status.".

This seemed straightforward for every test subject. Additionally one of the subjects suggested there could also be an "available" status. Even though we didn't implement this change, we think it is a valuable input, and we'll develop it for the next version of MACS.

7.2.8 Historical information

Test subjects were asked "Can you tell if you've broken a social norm in January?".

Everyone immediately clicked on the "history" link, analysed the entries, and concluded that they hadn't broken a norm in January.

7.2.9 Overall evaluation

The intended work-flow and user interfaces to support the smooth passage of the work-flow have been validated by the UX user testing. There wasn't any task the test subjects couldn't perform, and the issues we found were mostly related to a first-time usage lack of hints for some situations. All test subjects said they found MACS to be very easy and intuitive to use. We've improved MACS based on the feedback from the UX study, which made it easier to use for first-time users.

On a subjective note, there was a personal connection between the evaluator and the test subjects, and the evaluator was in the room, so there is a slight possibility that the evaluator was interfering with the test conditions. However, a visible and audible emotive reaction was observed when people read the apology, which indicated the apology had elicited an empathic response. After that, all test subjects were instructed to either forgive or ignore the apology, and they all decided to forgive the offender.

As future work, we would like to include a help section and, as referred on Section 7.2.3, make our own graphs, to make them more flexible. We believe MACS is ready to be used at a company, without causing any UX issues.

7.3 Heuristic evaluation against Ostrom's principles

Elinor Ostrom has defined 8 principles for governing the commons [122]. Most of these principles are relevant to our solution, which includes MACS and our proposed guidelines for workplace design. We've conducted an heuristic evaluation against the relevant Ostrom's principles, which follow:

Principle 1: Clearly defined boundaries: effectively excluding un-entitled parties

MACS is built to be used by people who share an open-space. People outside the open-space have no saying in the social norms definition and modification, and in the way people resolve incivilities amongst themselves. In this sense, MACS defines clear group boundaries.

Principle 2: Congruence between appropriation and provision rules and local conditions

People who are going to use the common goods are the ones defining the social norms, so these rules should reflect ways of using the common goods. However, MACS can't guarantee they do, because it has no saying in the social norms defined for a workplace. But we believe by giving the power to create the norms to the people who will abide by them, they can and will decide on their ideal way of sharing common goods.

Principle 3: Collective-choice arrangements

This principle states "individuals affected by the operational rules can participate in modifying the operational rules" [122] and this is one of the principles MACS is grounded on. With its participatory definition and adaptation of social norms, MACS fits the principle that those affected by the rules can participate in defining and modifying them.

Principle 4: Effective monitoring by monitors who are part of or accountable to the appropriators

MACS provides community members with a system for monitoring members' behaviour. It is intended to be used by people who share a workplace, and they all have the same kind of access to the system. They define the norms they are going to abide by and adapt them over time, through a voting system. Norm compliance is monitored by the members, as they are the ones flagging other people's violations of the social norms.

Principle 5: Graduated sanctions for resource appropriators who violate communal rules

Graduated sanctions progress incrementally based on severity of the violation and recidivism. MACS provides the tools for grounding graduated sanctions on, as it keeps historical data about violations of norms and the following actions, e.g. how many times someone has broken a specific norm, whether or not the offenders apologise, and whether or not the victims forgive the offenders.

Two of our proposed guidelines are relevant to this principle: "Making people aware of the graduated sanctions applicable for repeated violation of norms" and "Enforcing graduated sanctioning for repeated violation of norms".

Principle 6: Mechanisms for conflict resolution that are cheap and of easy access

MACS is an ICT solution, that through the convergence of affective, pervasive and adaptive computing can support and empower self-organisation to address problems of incivility in the workplace. Not only does MACS allow for people to flag violations of norms, it also lets offenders know their actions have violated the norms (many times people don't realise they've done something wrong until they are informed of it). Then MACS promotes dispute resolution, by allowing offenders to apologise and explain what happened, and victims to accept the offenders' apologies and forgive them.

Principle 7: Self-determination of the community recognised by higher-level authorities

MACS's social norms are defined by those who will abide by them, and only by them. This means even if management thinks they'd like to impose a social norm, the only thing they can do about that is to suggest it to the employees. That social norm will be inserted in MACS, only if everyone who would abide by it, agrees with it.

Principle 8: Nested enterprises, from the lowest level up to the entire interconnected system

This principle is the only one that is completely not applicable, as it is meant for a whole organisation, rather than a workplace.

7.4 Field trials

Two field trials were conducted to evaluate MACS and its influence in real workplaces. We were interested in performing an ethnographic study to assess whether or not people use MACS, whether or not MACS makes people more aware of the rules and of their own actions, and the general impact MACS has in the QoE of a workplace.

In the following subsections we will explain the methodology used in these field trials, describe each of the field trials separately, and finally discuss results, including similarities and differences between the two field trials.

7.4.1 Methodology

The field trials went through the following steps:

1. The users (people who share the workplace) filled in a questionnaire before starting to use MACS.
2. Social norms were determined and agreed by all users, as a group, and inserted in MACS.
3. Each user created their avatar and profile.
4. MACS was used in each workplace for two weeks.
5. At the end of the two weeks the users filled in another questionnaire.

The initial questionnaire, presented before each of the trials started, had the objective of assessing existing incivility issues, self-awareness and how well people know each other. It had the following questions:

- Have you ever done anything you think might be annoying for your colleagues?
- Are there any behaviours from your colleagues you find annoying/off-putting (in the workplace)?
- For how long have you been working in this open space?
- How well do you know each of your colleagues? (*Rate it from 1 (you only know his/her name but never speak to him/her) to 5 (you're friends outside the workplace)*)

The final questionnaire, presented after each of the trials ended, had the objective of assessing MACS's impact in the room environment, users' awareness of rules and theirs and others' behaviours. It had the following questions:

- Do you feel MACS has changed your office's environment?
- Has MACS made you more aware of your actions?
- Has MACS made you more aware of how other people's actions (not yours) could upset/annoy your colleagues?

- If you've flagged an event in MACS, do you think the person who broke the norms has changed their behaviour, after being notified of the violation by MACS? If so, in what way?
- If someone has flagged one action of yours as a violation of norms on MACS, what was your reaction to it?
- Do you have any comments/suggestions?

After the trials ended the database was analysed to find all the occurrences of flagging of episodes of incivility and outcomes of each of these flaggings – whether or not each episode had been validated, offenders had apologised and victims had forgiven/ignored offenders. Additionally we were interested in data about users' behaviours regarding the social norms, namely whether they had voted positively or negatively for social norms, whether anyone had suggested new social norms and whether new social norms had been created in MACS, as a result of suggestions and votes for new social norms.

7.4.2 Field trial 1 – Universidade do Porto

The first field trial was held at a room of researchers and PhD students at Universidade do Porto, in Portugal.

7.4.2.1 Set-up

The room was shared by ten people, of which three were females and seven were males. Eight of the people were Portuguese, one person was Colombian and one person was Iranian. All people except the Iranian person spoke fluent Portuguese.

The following notes were gathered from personal observation of the room and chats with the users:

- This was a small room, with desks and people located very close to each other.
- There was a window at the back of the room which sometimes caused some problems, as when closed, the room was too hot for people further from the window, and when opened, it caused a draft that affected the person sitting nearest to the window.
- There was a microwave oven and a coffee machine in the room.

- One of the people in the room expressed their concern about how MACS could influence the office environment negatively, as they believed people should confront each other when they have a problem, rather than flagging it anonymously. This same person did not agree with one of the norms proposed by a colleague, which stated that every time people are having conversations relevant to everyone in the room, these conversations should be in English. They told the person suggesting it "If you have a problem with me not speaking in English, you can tell me!".

There was a meeting to discuss the norms to be implemented in the room, and all norms were agreed on between everyone, except for the previously mentioned norm, with which one of the users disagreed, but all other nine people wanted to be imposed. Ideally there would be complete agreement, but when that does not happen, the majority of the people should decide. Table 7.1 presents the six actions that were considered violations of norms, along with their categories and severity levels. These social norms were inserted in MACS:

Table 7.1: Table of social norms initially defined for field trial 1, at Universidade do Porto.

Category	**Severity**	**Social Norm**
Noise	Critical	Noisy conversations.
Noise	Average	Phone conversations in the room.
Noise	Critical	Making noise.
Environment	Average	Opening/closing windows without asking.
Politeness	Average	Not speaking in English.
Politeness	Minor	Causing bad environment in the room.
Smells/Food	Minor	Smelly food.

7.4.2.2 Questionnaire filled in before using MACS

As explained before, the initial questionnaire was intended to assess existing situations of incivility in the room, self-awareness and how well people know each other.

Self-awareness

The question asked to assess self-awareness was "Have you ever done anything you think might be annoying for your colleagues?" and presented a few options and an open text area to expand on "Other behaviours". People could choose multiple answers. All users indicated some sort of self-behaviour that might be annoying to others.

In numbers, eight of the ten people indicated "Noise (headphones, mobile phones, talking in the room, etc.)". "Changing heating/cooling settings, opening/closing windows, etc. without asking for other people's opinion" was mentioned by four people. Three people said they've eaten smelly food in the room. Two people said they have been rude to a co-worker before. And finally, one person said they have borrowed co-workers' items without asking for permission.

Others' behaviours

When it comes to determining potential cases of incivility, by asking the question "Are there any behaviours from your colleagues you find annoying/off-putting (in the workplace)?", there were fewer positive answers. Only four people indicated their co-workers have annoying behaviours and three of those people said "noise" was the cause of annoyance. The fourth person did not specify which behaviours were annoying, they only said their co-workers have annoying behaviours at times, but they are "no big deal".

Longevity in the workplace and how well people know each other

People were asked "For how long have you been working in this open space?" and given a few time-range options. They were also asked "How well do you know each of your colleagues? (Rate it from 1 (you only know his/her name but never speak to him/her) to 5 (you're friends outside the workplace))". Longevity in the workplace seems to be related to how well people know each other, since people who've been in the workplace for the longest, seem to know others better and be better known by others. Only three people have been working in the workplace for under a year, and those are the three people who are less personally close with the remaining people in the room.

7.4.2.3 Using MACS

During the two weeks the trial lasted for, two episodes of incivility were reported in MACS, both for the same violation of norms, "Noisy conversations in the room", at two different times, with two different offenders and multiple victims.

Figure 7.3 will break down and provide more details about the two episodes of incivility that were reported on the first field trial:

<table>
<tr><th colspan="2">Reported episodes</th><th colspan="2">Offender's action</th><th colspan="2">Victim's action</th></tr>
<tr><th>result</th><th># episodes</th><th>action</th><th># episodes</th><th>action</th><th>#episodes</th></tr>
<tr><td>Not validated (score < 50%)</td><td>0</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="5">Validated (score > 50%)</td><td rowspan="5">2 (5 events)</td><td>"I didn't do it"</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Did nothing</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td rowspan="3">Apologised</td><td rowspan="3">2 (5 events)</td><td>Did nothing</td><td>0 events</td></tr>
<tr><td>Ignored</td><td>2 events</td></tr>
<tr><td>Forgiven</td><td>3 events</td></tr>
</table>

Figure 7.3: Break down of the two episodes of incivility (comprised of five events) for field trial #1. The green areas indicate the path where an event went from being flagged, to being validated, to the offender apologising, and finally to the victim forgiving the offender.

The first event was reported by two people and the offender promptly apologised with an explanation "Sorry for causing trouble. I'll try to improve on that.". Both victims accepted the offender's apology and the offender's reputation was therefore nearly restored.

About fifteen minutes later on the same day, the second event was reported by three people. The offender apologised promptly, adding the explanation "Sorry for having such a loud and manly voice.". Only one of the three victims accepted the apology and the remaining two have ignored it, so the offender's reputation was only increased by a small amount.

An analysis of the final questionnaire will shed some light towards the reasoning behind these behaviours.

7.4.2.4 Questionnaire filled in after using MACS

The final questionnaire, as indicated before, had the intention of assessing the impact MACS had had in the workplace and how it influenced people's awareness and fulfilment

of the norms. Nine of the ten users have answered this questionnaire.

Impact in the workplace environment

The first question asked "Do you feel MACS has changed your office's environment?" and users were given three options: "Yes, positively", "Yes, negatively" and "No". Five people said the office environment had been changed positively, three people said there was no change in the environment, and one person said the change was negative.

The person who said the change was negative was one of the people who had broken social norms and whose actions had been flagged, and the same person who had expressed worry about MACS having a negative impact in the office environment, as he believed people should confront each other. His apology was accompanied by an arguably sarcastic comment, and was not well received by two of the three people who had flagged his behaviour, who chose to ignore it, rather than accept it.

Self-awareness

The question "Has MACS made you more aware of your actions?" was intended to assess in what way self-awareness might have changed with the use of MACS. Users were presented with the following options, of which they had to choose one:

- I was already aware, but I've become more aware with MACS.
- I wasn't very aware (or aware at all) and I've become more aware with MACS.
- I was already fully aware, so MACS didn't change anything.
- I don't think I ever do anything that might upset/annoy my colleagues, and MACS didn't change anything on my perception.

Six out of nine people chose the first option, saying even though they were already aware of their behaviours, MACS had made them more aware of them. Two people chose the second option, saying they weren't very aware (or aware at all) but MACS had made them more aware. And finally one person said they were already fully aware before using MACS, so their awareness had not changed.

Awareness of other people's behaviours

The question "Has MACS made you more aware of how other people's actions (not yours) could upset/annoy your colleagues?" had the intention of showing how people's awareness about their co-workers' behaviours had changed with the use of MACS. Users were presented with the same options from the previous question, with only a slight change to the last item, to "I don't think other people ever do anything that might upset/annoy my colleagues, and MACS didn't change anything on my perception.".

Here seven people chose the first option, saying they were already aware of others' behaviours, but MACS had increased their awareness. One person said they weren't very aware (or aware at all) of others' behaviours and became more aware with MACS. And only one person said they do not think others ever have an annoying or upsetting behaviour, so MACS did not change their perception.

Victims' comments about the events they have flagged

We were interested in knowing what the victims' view on the events they'd flagged was, regarding the offenders' behaviours. For that, we asked: "If you've flagged an event in MACS, do you think the person who broke the norms has changed their behaviour, after being notified of the violation by MACS? If so, in what way?".

The two events reported on MACS had had two and three victims, respectively. Regarding the first event, both victims said the offender showed a more careful behaviour after being flagged. When it comes to the second event, all three victims said the offender's behaviour had not changed and one of the victims added "I think this system needs to be involved with some kind of commitment, because I think some people don't put much value if they lose their credit in the system."

Offenders' reactions to having been flagged

The question "If someone has flagged one action of yours as a violation of norms on MACS, what was your reaction to it?" was answered by the two people whose actions had been flagged.

The person who had been flagged by two people, had apologised and had been forgiven by the two victims, wrote "I think it was fair, although I tried to perturb the less I could.".

The person who had been flagged by three people, but had presented an arguably sarcastic apology, and consequently only one of the three people had forgiven them, wrote the following text:

"It made me think not on how to behave inside the office but how to respond to the accuser. Play vendetta and flag him for a past behaviour, where I could have had the chance of flagging him as well? Or simply let it go? Should I address him directly? I decided to ignore. And by ignoring I signalled the message that I didn't care at all, which was effective considering that I repeated the behaviour (like everyone else in the office) but not more flags were raised.

The bottom line and interesting thing is that having been flagged did not make me more aware of disruptions in the office but rather more conniving, which is certainly something I dislike of being".

7.4.3 Field trial 2 – Robotics Lab, Imperial College London

The second field trial was held at a room of researchers and PhD students at a Robotics Lab at Imperial College London, in the United Kingdom.

7.4.3.1 Set-up

The room was shared by nine people, of which four were females and five were males. They were from nine different countries, but two pairs of people shared a native language, Spanish and Greek, respectively.

The following notes were gathered from personal observation of the room and chats with the users:

- This was a medium-sized room, with people, robots and an electrical workstation.
- There was a water filter bottle in the room that was shared by everyone.
- There seemed to be a generalised good relationship between everyone in the room.

As with the first field trial, there was a meeting to discuss the social norms to be implemented in the room, and most norms were agreed on between everyone. However, two of the norms were decided by majority. The eight following actions and respective categories and severity levels were considered violations of norms, and were inserted in MACS:

Table 7.2: Table of social norms initially defined for field trial 2, at the Robotics Lab, Department of Electrical Engineering, Imperial College London.

Category	Severity	Social Norm
Noise	Average	Mobile phones ringing.
Noise	Critical	Talking on the phone (which includes Skype calls).
Noise	Critical	Making noise.
Environment	Minor	Not switching monitor off when going home.
Environment	Average	Being messy in the common space.
Environment	Average	Not refilling the water bottle when it goes below a level.
Politeness	Critical	Over-joking.
Politeness	Minor	Speaking other languages (other than English).

7.4.3.2 Questionnaire filled in before using MACS

As explained on the previous section, the initial questionnaire was intended to assess existing situations of incivility in the room, self-awareness and how well people knew each other.

Despite the fact that there were nine people in the room and everyone created a profile, one of the people never logged in MACS and did not fill in the questionnaire, so all data will be about eight people.

Self-awareness

The question asked to assess self-awareness was "Have you ever done anything you think might be annoying for your colleagues?" and presented a few options and an open text area to expand on "Other behaviours". People could choose multiple answers.

Everyone showed self-awareness, as they indicated at least one behaviour of theirs that might be annoying to others. Five of the eight people indicated some sort of noise behaviour, either the pre-selectable "Noise (headphones, mobile phones, talking in the room, etc.)" or other noise-related issues. "Changing heating/cooling settings, opening/closing windows, etc. without asking for other people's opinion" was mentioned by two people.

Also two people have said they have been guilty of borrowing other people's items without asking for permission. One person said they've eaten smelly food in the room and one person said they have been rude to a co-worker before. Also one person said they sometimes do not turn off the monitor when they leave work.

Others' behaviours

When it comes to determining potential cases of incivility, by asking the question "Are there any behaviours from your colleagues you find annoying/off-putting (in the workplace)?", only one person did not indicate any behaviour of others that they find annoying. All remaining seven people referred at least one noise-related issue, although two of them added that that behaviour is only annoying when they, or others, are trying to focus on work. Other than noise, two people mentioned people being messy in the common areas and one person said they don't like it when people tell others how to behave.

Longevity in the workplace and how well people know each other

People were asked "For how long have you been working in this open space?" and given a few time-range options. They were also asked "How well do you know each of your colleagues? (Rate it from 1 (you only know his/her name but never speak to him/her) to 5 (you're friends outside the workplace))". Most people (six) have been sharing the workplace for over a year and in general, people know each other well.

7.4.3.3 Using MACS

As it happened on the first field trial, this trial happened for two weeks. During this time, multiple episodes of incivility were reported in MACS, with different people acting as victims and offenders on different episodes of incivility. People also voted for existing norms and suggested new norms, with two new norms being created in MACS halfway through the field trial.

Regarding the flagging of episodes of incivility, thirty-six episodes were flagged on MACS, comprising of forty-nine events. This means people have clicked on someone's avatar to flag their behaviour forty-nine times, but some of those flags were related to a same episode of incivility. These episodes of incivility had between one and three victims.

Figure 7.4 will break down and provide more details about the thirty-six episodes of incivility that have been reported during the field trial:

<table>
<tr><th colspan="2">Reported episodes</th><th colspan="2">Offender's action</th><th colspan="2">Victim's action</th></tr>
<tr><th>result</th><th># episodes</th><th>action</th><th># episodes</th><th>action</th><th>#episodes</th></tr>
<tr><td>Not validated (score < 50%)</td><td>5 (5 events)</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="5">Validated (score > 50%)</td><td rowspan="5">31 (44 events)</td><td>"I didn't do it"</td><td>11 (11 events)</td><td>-</td><td>-</td></tr>
<tr><td>Did nothing</td><td>6 (6 events)</td><td>-</td><td>-</td></tr>
<tr><td rowspan="3">Apologised</td><td rowspan="3">14 (23 events)</td><td>Did nothing</td><td>3 events</td></tr>
<tr><td>Ignored</td><td>12 events</td></tr>
<tr><td>Forgiven</td><td>8 events</td></tr>
</table>

Figure 7.4: Break down of the thirty-six episodes of incivility (comprised of forty-nine events) for field trial #2. The green areas indicate the path where an event went from being flagged, to being validated, to the offender apologising, and finally to the victim forgiving the offender.

The thirty-one episodes of incivility that were validated by MACS were composed of forty-four events, since, as explained before, an episode of incivility is a set of one or more events – as many as the number of people who have flagged the episode of incivility. The five episodes that MACS has not validated had a single victim, as did the seventeen validated episodes where the offender either stated they had not broken the norms, or took no action.

The fourteen episodes of incivility where the offender has apologised were composed of twenty-three events. In nine of those apologies, the offender added an explanation. Seven of these episodes had one single victim, and the three events where the victim has done nothing about an apology are part of this group. Five episodes of incivility from this group had two victims and two episodes had three victims.

The flagging of episodes of incivility did not follow a linear path. The two Wednesdays of the field trial seemed to have spikes of flagging. On the first day, a Wednesday, fourteen episodes of incivility (composed of twenty-three events) were reported on MACS. Only two episodes of incivility were reported between that Wednesday and the following Wednesday, where thirteen episodes of incivility (composed of seventeen events) were reported. The following day seven episodes of incivility, all with a single victim, i.e. with seven events, were reported on MACS.

When it comes to social norms, only one of the eight social norms established for the workplace, "Not switching off monitors", was either not broken or broken but not flagged. Most of the flagged episodes regarded noise-related social norms, with twenty-six noise-related events being flagged. "Politeness" was a close second, as throughout the trial twenty events of this kind were flagged.

Five new norms were suggested for the workplace by four different people. The first suggestion happened six days after the trial had started. These norms were sent out to all of MACS's users for voting and two new norms were created, as those were the only ones with the vast majority of people agreeing they should be implemented. The new social norms were "Using the meeting rooms without booking them, or at least checking if they are booked beforehand.", with category "Politeness" an severity level "Critical" and "Misusing Snowden", with category "Environment" and severity level "Average".

The analysis of the final questionnaire will better explain the reasoning behind the behaviours regarding the flagging of offences, apologies and the consequent ignoring or forgiving the offender, by the victims, and how they relate to the existing social norms.

7.4.3.4 Questionnaire filled in after using MACS

As it happened on the first field trial, the final questionnaire had the intention of assessing the impact MACS has had in the workplace and how it influences people's awareness and fulfilment of the norms. All of the eight users who actually used MACS (one person never logged in or responded the first questionnaire) have responded this questionnaire.

Impact in the workplace environment

The first question asked "Do you feel MACS has changed your office's environment?" and users were given three options: "Yes, positively", "Yes, negatively" and "No". Five people said the office environment had been changed positively, two people said there was no change in the environment, and one person said the change was negative.

The person who said the change was negative was the user who ended the week with the lowest reputation, and was flagged as an offender in eleven episodes of incivility (with nineteen events). He had apologised in six episodes of incivility, that had twelve events. This means victims were presented with the possibility of accepting or ignoring his apology twelve times (one time for each victim/episode of incivility) but in ten of those twelve times, the victim ignored his apology, and only in two occasions has the victim forgiven him.

Self-awareness

The question "Has MACS made you more aware of your actions?" was intended to assess in what way self-awareness might have changed with the use of MACS. Users were presented with the following options, of which they had to choose one:

- I was already aware, but I've become more aware with MACS.
- I wasn't very aware (or aware at all) and I've become more aware with MACS.
- I was already fully aware, so MACS didn't change anything.
- I don't think I ever do anything that might upset/annoy my colleagues, and MACS didn't change anything on my perception.

Six out of eight people chose the first option, saying even though they were already aware of their behaviours, MACS had made them more aware of them. One person chose the second option, saying they were not very aware (or aware at all) but MACS had made them more aware. And finally one person said they were already fully aware before using MACS, so their awareness had not changed.

Awareness of other people's behaviours

The question "Has MACS made you more aware of how other people's actions (not yours) could upset/annoy your colleagues?" had the intention of showing how people's awareness about their co-workers' behaviours has changed with the use of MACS. Users were presented with the same options from the previous question, with only a slight change to the last item, to "I don't think other people ever do anything that might upset/annoy my colleagues, and MACS didn't change anything on my perception.".

Here five people chose the first option, saying they were already aware of others' behaviours, but MACS had increased their awareness. Two people said they were not very aware (or aware at all) of others' behaviours and became more aware with MACS. And one person said they were already fully aware, so MACS did not change anything in their awareness.

Victims' comments about the events they have flagged

The open question intended to understand the victims' view on events they had flagged, regarding the offenders' behaviours was "If you've flagged an event in MACS, do you think the person who broke the norms has changed their behaviour, after being notified of the violation by MACS? If so, in what way?".

There were very different answers to this question. One person said when she flagged someone's violation of norms, that person changed their behaviour and avoided breaking that social norm again. Another person said he thinks in general people became more considerate towards each other in the workplace, "noticing the small things that can annoy other people, such as filling the water jug or speaking in other languages".

One person said his reputation was so low, the only time he flagged someone's violation of norms, MACS did not validate the episode of incivility. A different person said behaviours had not changed at all, and people continued breaking the norms.

Finally one person stated she did not feel very uncomfortable when people flagged her behaviours and she does not think people had changed their behaviours at all.

It is important to note that these are different victims and they refer to different episodes of incivility with different offenders, hence the disparity in behaviours following a flagging of violations of norms.

Offenders' reactions to having been flagged

Several people had their actions flagged on MACS in this trial, and therefore the open question "If someone has flagged one action of yours as a violation of norms on MACS, what was your reaction to it?" was answered by five people.

One person said she had been flagged for breaking a social norm that she believes was misinterpreted by whoever had flagged her behaviour. The social norm is "Speaking other languages" and this person said that her interpretation of this norm is "As far as I understand, the norm should be applied if we're all in a group of mixed languages and we're all talking together" and argued that she was having a private conversation, and therefore she did not apologise for having broken the norm, or change her behaviour afterwards. On another episode the same person was flagged for "Making noise", as she was having a conversation in the room. She stated she was trying to speak in a low voice, but the

workplace was particularly quiet at the time, and therefore other people could hear her. She apologised for this action.

Another person said that on occasions where her behaviour was flagged and she felt like she really had broken the social norms, she apologised for doing so. However, at times she felt her behaviours were flagged unfairly, as she thought she did not break the social norms at all, and this had made her feel bad.

A different person said that using MACS was a slightly frustrating experience, as "most of the complaints were due to making noise during Skype meetings which are part of my day to day work. Then my reputation went so low, that when I actually tried to flag an event it was rejected". One of the people who had flagged an episode of incivility where this person was having a Skype meeting, stated that even though they know the Skype call was work-related, they feel these calls were always very long and this person could take them in the conference room instead.

Someone else said every time he felt he had broken the social norm he'd been accused of breaking, he apologised for having done so.

And one last person said she just flagged people's behaviours because having set the social norms had made her more aware of events which she would not normally care about.

From the analysis of this question it seems clear people only apologised whenever they felt the accusation that they had broken a social norm was fair, and never did it to try and improve their reputation.

Additional comments from users

People could add comments or suggestions on a free text area in the questionnaire and six of the eight people did so.

Three people said they think MACS would work better in larger workplaces, since with only a few people using it, it is relatively easy to know who has flagged their behaviours.

One person said in his opinion the initial meeting where everyone agreed on social norms for the workplace was the action that had the most impact in the whole field trial, as "I think most people just weren't aware of what disturbs others (or not) and trying to define the social norms collectively in terms that can be entered in MACS made them clearer". He also added that he felt MACS worked in a dissuasive way, as "people would joke that you will get flagged on MACS if you do this or that".

Someone said he felt it was very hard to redeem himself when his behaviour was being systematically (and unfairly at times) flagged.

Another person said that MACS might be more effective if the reputations were used to award people " every week/month. Like employee of the month!".

7.4.4 Overview and discussion of the field trials' results

This overview and discussion will have four subsections, one for each of the questionnaires that people had to answer before and after using MACS, respectively, a subsection about people's interaction with MACS, and a final discussion about general considerations and observations.

7.4.4.1 MACS

Even though both field trials happened on a same type of working environment, a workplace shared by PhD students and post-doc researchers, they had very different levels of participation. The first field trial only had two reported and validated episodes of incivility, composed of five events, whereas the second field trial had thirty-six reported episodes of incivility, comprising forty-nine events. Five of these episodes of incivility were never activated, as they were not validated by MACS.

On the first field trial there were only two offenders, who had very different attitudes towards being flagged. One of them apologised, both victims forgave him and he changed his behaviour. The other one apologised, but added an arguably sarcastic explanation, which led to two of the three people who had flagged him not to forgive him.

The second field trial had all types of situations:

- People flagging someone's behaviour and it not being validated.
- People flagging someone's behaviour, it being validated, and consequently:
  - The offender saying they did not do it.
  - The offender doing nothing about the flagging.
  - The offender apologising, and consequently:
    - The victim accepting the apology, i.e. forgiving the offender.
    - The victim ignoring the apology, i.e. not forgiving the offender.

* The victim doing nothing regarding the apology.

One of the people in the second field trial was flagged more than anyone else and ended the trial with a very low reputation. The victims who flagged him only accepted his apology two times, out of twelve, and one of these victims stated that the offender knew he was breaking the social norms and could have made noise elsewhere, and therefore he has not accepted his apology. The offender's reputation was reduced quickly and with the victims not accepting his apology, it was very hard for his reputation to go back up. The offender said he found this situation frustrating, because by the time he wanted to flag someone's violation of norms, his reputation was so low, MACS did not validate it. This is an indication of an existing issue and it would be one of the rare occasions where the manager could intervene and try to sort this problem out.

Regarding social norms, the second group was also more active than the first, as they suggested five new social norms for the workplace. Those norms were sent to the whole group to vote for whether or not they wanted the norms to be added to MACS and what severity level they felt the norm should have, if they had voted positively for it. Two new social norms were added to the existing list of eight norms for the Robotics Lab.

7.4.4.2 Questionnaire answered before using MACS

As explained before both workplaces were of the same type, an academic environment, and a similar size. The first group had ten people, but only nine answered the questionnaires and the second group had nine people, but only eight participated in trying MACS and answering the questionnaires.

The answers to the first questionnaire's question about self-awareness were very similar from both workplaces. Everyone showed self-awareness, by indicating some sort of behaviour of their own that they think others might find annoying.

On a personal note, the first questionnaire was presented to the users after they were told about how MACS works and its objective, and thinking about that could have influenced people's answers. When compared to the answers to the questionnaire answered by 125 people a few years earlier (presented in 3.3.3), where 65.6% of people indicated they were guilty of some annoying behaviour, this 100% value of self-awareness seems to be too high. This could not, however, be avoided, as in order for a group of people to agree to

test MACS, they need to first be informed about what MACS's objectives are and how it deals with incivility.

7.4.4.3 Questionnaire answered after using MACS

This questionnaire also had similar answers when it concerns the effect MACS has had in the workplace. In both cases five people said MACS had changed the office environment positively and one person said it had changed it negatively. In both cases, the person saying the office environment had changed negatively was also the person whose reputation was the lowest, as they had broken the social norms.

Regarding their self-awareness, answers from both workplaces were also very similar, with six people saying they were already aware of their actions, but MACS had made them more aware of them. When it comes to others' behaviours, in both cases most people said they were already aware of other people's behaviours but MACS has made them more aware of them.

Judging by these responses, it seems for most cases MACS changes people's perceptions of potentially annoying behaviours, making them more aware of their own actions that might be upsetting or annoying for co-workers, and also more aware of their co-workers' behaviours.

7.4.4.4 General observations and considerations

In general terms MACS was well accepted by both groups of people. Both groups were very interested in establishing social norms for their workplaces, and as someone has referred on the last questionnaire, this was what started to make people aware of behaviours that might be annoying to others.

The mere presence of MACS in the workplace seems to have a placebo-effect, as it makes the social norms more perceptible, and some people try not to violate them.

Not all sorts of people will agree with having MACS in their workplace. Even though this was not visible in the second group, the first group had someone who was very critical of MACS from the beginning and did not change his attitude throughout the experiment. It bears the question "will people who are more prone to breaking the social norms oppose to the implementation of MACS in their workplace?".

Some people felt frustrated for being flagged for violating norms they did not believe they were breaking. It might be relevant to change the reputations penalties for breaking

norms in these situations, so the penalties could be lower if the offender stated they had not done what they had been accused of.

People have commented on how if reputations were associated with either sanctions or awards this might make people more willing to follow the social norms.

An interesting outcome of the field trials came from the second group. They showed how the action of adapting norms works, as in only a few days people realised they were missing some norms and proposed them. The fact other people in the workplace approved two of the proposed social norms, by voting, and they were then created in MACS, shows the importance of dynamic adaptation of social norms.

7.5 Summary

Our proposed solution is composed of MACS and guidelines for workplace design. This chapter has described all the different evaluations conducted to validate the solution: A UX evaluation, a heuristic evaluation against Ostrom's principles and two field trials.

MACS went through a UX user study, which has validated the intended work-flow, and user interfaces to support the work-flow's smooth passage. The UX user study's findings have led to a few simple changes. Even though some features weren't as intuitive as we'd expected while designing them, the overall opinion about using MACS was that it was easy to understand and use, and most of the suggested changes concerned providing more hints to a first-time user, rather than changing interactions or functionality. This meant changes were quick and easy to implement.

Our solution, composed of MACS and the guidelines for workplace design, has had a heuristic evaluation against Ostrom's principles for managing a commons. From this evaluation we've concluded the solution follows seven of the eight principles, with the remaining one not being applicable to this case, as it refers to a whole company, rather than a shared workplace.

Finally, MACS has been evaluated in two field trials, where it was in use in two different workplaces for two weeks. Both field trials happened on a same type of working environment: A workplace shared by PhD students and post-doctoral researchers, but in two different countries, Portugal and the United Kingdom. Both field trials had episodes of incivility being reported by multiple victims and situations of apology and forgiveness.

The second field trial had two new social norms being added to MACS a few days into the experiment, as people suggested new norms and everyone voted for them.

MACS is therefore a working solution for addressing incivility in shared workplaces with dynamic adaptation of social norms. It creates self-awareness and awareness about other people's behaviours, and, for most cases, makes people know the social norms and remember they exist, and consequently try to abide by them.

8

Conclusions

8.1 Introduction

This chapter, the last of this thesis, includes a summary of the work done during the course of this project, its limitations and ideas for future work when it comes to further developments, further research and further testing.

8.2 Summary

Today's organisations are characterised by fast-paced relationships between co-workers, often mediated by high-tech, asynchronous communications [3, 129]. All these can be facilitators for employees' mistreatment of one another. Among these mistreating behaviours, is workplace incivility.

Workplace incivility is considered to be a contemporary workplace crisis, and the entry level form of workplace mistreatment [100]. It is a low-intensity form of deviance, with ambiguous intent to harm the victim, and therefore it is not always easy to detect and address [3]. However, when nothing is done to stop incivility from happening again and again, and/or punish the offenders, it can have serious consequences. It might lead to an incivility spiral, where a set of retaliation actions are taken by both offender and victim, where they alternate the roles of offender and victim. The intensity of the offence increases on each consequent action, and this whole process might then escalate into a more serious type of deviance, e.g. conflict or aggression [3, 128]. Incivility might also cause work-related disturbances, victims' mental and physical health problems [43, 102] and personal

life repercussions [102]. It is essential for researchers to find ways to reduce the negative effects of workplace incivility [116].

In this thesis, we've presented MACS, a system designed and developed to deal with the problem of workplace incivility. MACS is a platform for successful collective action, grounded on participatory adaptation and fair information policies. Based on the premise that those affected by rules have the right to modify them [122], future MACS's users – people who share a workplace with each other – are asked to define an initial set of social norms by which they'll all abide. After those norms are inserted in MACS, people can anonymously flag their co-workers' violations of norms. If MACS considers an event where someone flags someone else's violation of norms to be valid, it notifies the offender. Consequently, the offender can apologise and explain what happened, and that feedback is taken back to the person or people who'd flagged the offender's behaviour. The victim(s) can, then, accept the apology, hence forgiving the offender.

Forgiveness mediates and settles disputes, to sustain healthy long-term relationships [112], can increase the perceived debt of the transgressor to the victim [91], and can reduce stressful reactions to transgressions, thus lowering health risks and promoting health resilience [171]. Additionally, a forgiving attitude, rather than a vengeful one, promotes cooperation [7], which, in current workplaces, is often desirable, if not mandatory. Forgiveness could therefore increase interpersonal connectedness, as being accepted or welcomed increases the feeling of belongingness and leads to positive affect. It has also been shown, in CMC, an apology and an action to try and repair the harm done, can alleviate the offence and restore trust [162].

By allowing offenders to apologise and explain why they've broken the norms, then sending that apology to whoever had flagged the offender's behaviour, and subsequently enabling the victims to forgive the offender, MACS should help to restore the workplace environment to an homoeostatic equilibrium. This apology and forgiveness process is the most relevant part of MACS, when it comes to solving disputes and removing instability.

Another of the pillars MACS is based on is the participatory adaptation of social norms. The norms are defined by the people who will abide by them, and only those people. Social norms are not stable by nature, so after this initial definition, over time, they might become obsolete, require to be changed, or new norms might arise. MACS allows everyone affected by the social norms to vote positively and negatively for existing norms, and suggest new norms. If norms are determined and adapted by people who will

abide by them, it is more likely they'll feel happy complying, rather than following norms they might not agree with, and on the definition of which they didn't have a saying.

MACS's UX has been studied throughout its creation and development. The initial prototypes were evaluated by colleagues, and a very preliminary version of MACS was installed in a room with 14 PhD students. This has validated some design choices, which were then evolved into the final interface and interactions. MACS's final version went through a UX user study involving asking test subjects to follow a script on MACS, while thinking-aloud and being filmed. The script is intended to make them interact with all of MACS's features. The footage was then analysed to conclude the overall opinion was MACS is user-friendly and fit for purpose. Evidence from this study suggests MACS would have a positive effect on removing instability in the workplace.

Another of the contributions of this thesis is the proposal of guidelines for workplace design. These guidelines reflect the need for companies to have clear and congruent social norms, defined by the people who will have to abide by them, so that these norms make sense to those who will have to live by them. Explicit sanctions should be assigned to the violation of each norm, but as micro-managing should be avoided, these sanctions should only be applied when problems can't be resolved amongst the parties involved in episodes of incivility. In order for people to be able to solve situations of incivility amongst themselves, companies should provide ways to facilitate that, and including a system such as MACS would be a way of doing so.

All the study of emotions, social norms, workplace deviance and forgiveness, made through the course of this project (Chapters 2 and 4), has led to the conceptualisation and development of MACS (Chapters 5 and 6), and the proposal of guidelines for workplace design (Chapter 6). Our solution is composed, therefore, of MACS and the design guidelines.

Our solution has had a heuristic evaluation against Ostrom's eight principles for managing a commons [122]. One of the principles is not applicable to the workplace setting, as it involves a whole organisation, but the remaining seven principles were matched with the solution we've proposed, so we believe this is an adequate response for trying and solve the workplace incivility problem and improving the quality of experience in the workplace.

Finally MACS has had two field trials to evaluate its behaviour when implemented in real workplaces. Each of the field trials happened for two weeks, in two academic workplaces, with users being either PhD students or post-doctoral researchers. Each of

the workplaces was in a different country: Portugal and the United Kingdom. Both field trials had episodes of incivility being reported by multiple victims and situations of apology and forgiveness. One of the field trials had new social norms being added to MACS a few days into the experiment, after people had suggested them and everyone else in the workplace had voted for them.

MACS is therefore a working solution for addressing incivility in shared workplaces with dynamic adaptation of social norms. It creates awareness about own and others' behaviours and, for most cases, makes people aware of both the social norms and how violating them impacts on other people's work and life.

8.3 Limitations and future work

Even though implementing most of its desired functionality, MACS, due to its complexity, could not include all the features we would have liked to include, such as automatic detection of environmental signals, affective dissonance and an affective interaction module.

This section will present several routes of research, development and testing that would be interesting to explore further.

8.3.1 Further developments

Future developments are the parts of future work that involve coding, and in some situations, the addition of hardware to MACS.

Positive flagging and feedback

At the moment MACS exclusively allows for people to flag violations of social norms. The existing problem is incivility and in order to solve it, flagging negative behaviours seems to be the urgent and logical solution.

However, MACS collects daily information about how much each of its users comply with norms. By analysing reputations and historical data, it is easy to infer which people consistently respect the norms, and which people have improved their behaviour over time. There are, therefore, three ways in which MACS could provide a positive outlook on co-workers' interactions:

- By analysing reputations and historical data, MACS could, from time to time, **provide positive feedback to users** who have good reputations and users whose reputations have been consistently evolving positively for some time.
- **By allowing positive flagging** to be created, so users could indicate someone else invariably complies with a norm.
- **By allowing the creation of positive norms** and mirroring the interaction: if someone was flagged for a positive norm, their reputation would be increased, and instead of a button for apologising, there would be a button for saying "Thank you".

The reducing and removal of situations of incivility should improve the quality of experience in workplaces on its own, but as positive affect has an influence in decision-making and efficiency [83], social behaviour and thought process [82], creative problem solving [5] and happiness [104], we believe by integrating this positive outlook, MACS could improve the quality of experience in the workplace even further.

Affective interaction

As explained on Section 4.2, the affective computing field has branched into three different routes. We're more interested in the affective interaction route, as the aim of integrating affect in MACS isn't to determine what specific emotions users are experiencing, but simply to have an idea of valence and intensity of the emotions people are experiencing.

Therefore, although there are various descriptions for affect, we consider Russell's circumplex model of core affect [144] to be the more useful in our setting, because of its simplicity and ability to capture a wide range of emotions [44] in its multidimensional emotional space.

If a person is affected by an offender's action, the set of affective states they might experience will probably be found on one of the left quadrants, which represent unpleasant emotions. High activation negative emotions, e.g. anger and frustration, can be found on the top left quadrant and low activation ones, e.g. sadness, on the bottom left quadrant.

Affective states in both upper quadrants, on the other hand, might be interesting to monitor, as they represent high activation emotions, that might be the cause for some people's violation of the social norms. For instance if someone's just received some very good news, they might be over-excited and become momentarily louder, thus upsetting

someone else's work. This affective state is found on the upper right quadrant. But also if someone is feeling frustrated or angry, they can express their feelings loudly and upset someone else's work.

Combined with the previous description of further development, where we would like to include positive feedback in MACS, we'd like to analyse the impact of positive feedback in users' affective states. Ideally their affective states would move in the horizontal axis to a more positive affective state. Therefore, the positive side of the valence axis can be seen as the valence level goal. If the working environment can, in fact, be improved by the use of MACS, the people who work there should probably be experiencing emotions that fall in the right side of the valence axis.

It has been shown affective dissonance, i.e. change in the physiological signals, can be derived by using devices for measuring galvanic skin response [67, 130]. A new version of MACS should integrate such devices and look for affective dissonance at (or close to) the time the victim claims there was a violation of norms. If there is indeed a variation, it is more likely the person felt upset and their claim is a valid one.

Affective information gathered in MACS could then be used to enhance the quality of experience in the workplace in multiple ways, each of which will be expanded in the following paragraphs.

Information about affective dissonance could be used for validation of events: When a new event is created, i.e., someone flags someone else's violation of norms, data about affective dissonance from both sides (victim(s) and offender) could be used as an additional variable for validation. Not always, but most of the time, we'd be looking for negative emotions on the victims' side, and active emotions on the offender's.

Arguably, when someone is experiencing negative affective states, such as sadness or stress, someone else's violation of norms will have a more dramatic impact, than when they are experiencing positive ones, such as happiness or relaxation. Colour-coded information about affective states could be used as a hint about users' affective condition at a given moment. This could be presented in the list of avatars of co-workers, as a colourful frame around each person, that could indicate an inclination of mood/affective state. This could potentially make people more aware of each others' humanity and disposition, and work as an additional cue for knowing when breaking the norms would be even more critical than usual.

MACS integrates a self-reported "do not interrupt" status. As it is developed, people have to deliberately report they are busy on times where that happens. This status is reset every night, to avoid busy statuses caused by forgetfulness, rather than the will not to be interrupted. This, along with the affective interaction data, could be turned into valuable information regarding stress and dissatisfaction levels people in the workplace might be experiencing. If a person constantly indicates they do not want to be interrupted, and/or their emotions seem to be negative most of the times, this could be used by management to try and understand what is going on with the person and try to make changes to improve their situation.

Event recognition

MACS relies on its users to indicate whenever a social norm is broken, but doesn't integrate any event recognition sensors. It would be interesting to add this to a future version of MACS. Whenever an event is created, a social norm is implied. One way of confirming whether or not that norm was, as claimed, broken, would be to use environment sensors, as long as the violation of the norm is liable of being measured in some way. It would be possible to use sensors to verify violations of noise and temperature-related norms.

One way of detecting noise-related events is to capture sound using microphones and then using triangulation techniques to infer the location of the sound. The microphones would detect background noise and look for spikes close to the time an event flagging the violation of a noise-related norm is created.

The information obtained from these environment sensors would then be used as another variable in the assessment of the validity of an event.

These sensors might aid validating events, e.g. if someone's phone starts ringing and they are not in the room, and someone flags this behaviour, sound level sensors might indicate that the sound volume was indeed, excessively high.

Better graphs

As explained in Section 5.5.4, MACS uses Google Charts [1] to display the reputations graphs. Even though Google Charts has provided a good effective solution for a simple display of reputations, we would like to have more flexibility, with different colours in different sections of the graph, to reflect features such as changes in reputation description, different labels, or captions.

Therefore, as future work, we would like to implement our own graphs, which will make them more flexible and entirely customisable to our needs.

"Available" status

On the UX user testing one of the test subjects has suggested the same way MACS allows users to update their "busy" status, it could also allow them to update an "available" status. This is an interesting suggestion, regarding providing ways to reduce unwanted interruptions, as additionally to informing co-workers about times where they would rather not be interrupted, users could also let their co-workers know when it would be a preferable time to interrupt.

This should be implemented in the "busy" toggle feature, where each click moves from neutral, to busy, to available, to neutral, and so on.

Help section in MACS

As straightforward as a system's interface might be, it is always a good idea to have a "help" section, to make sure if a user gets lost, they know how to solve their problem.

A "help" section should be implemented on a next version of MACS.

8.3.2 Further research

This subsection will present the research routes we think would add value to this thesis work. These are opportunities for user studies that shouldn't involve additional coding or insertion of new features on MACS.

Emotional contagion

Emotional contagion is defined as "the tendency to automatically mimic and synchronise expressions, vocalisations, postures and movements with those of another person's and, consequently, to converge emotionally" [76].

Emotional contagion is a well documented phenomenon and it has been shown it happens not only on social settings, but also in the workplace [10, 22, 86, 157]. Positive emotional contagion can improve cooperation, decrease conflict and increase perceived task performance [10].

It seems possible that MACS could boost positive emotional contagion, particularly if the positive feedback feature is implemented. Therefore it would be interesting to study ways in which MACS influences emotional contagion, and ways to influence it even further.

Cultural factors

Multi-cultural employees are a reality for many organisations, particularly in big cities. The cultural background influences verbal and non-verbal communication, and sometimes issues arise from misinterpretation of e.g. cultural emblems [1], facial expressions or tone of speech.

It would be interesting to find out in what way cultural factors make people interact more or less with certain features in MACS, and whether MACS could have ways of making people aware of cultural differences, so people would be more informed and cultural clashes would happen less frequently.

Personality types

The Big-Five personality traits are five broad dimensions of personality, sometimes referred to as OCEAN, which stands for the traits' initials. Each of these traits represent a range in which someone has [84]:

- Openness – intellectual, imaginative, independent-minded vs. consistent, cautious.
- Conscientiousness – orderly, responsible, dependable vs. easy-going, careless.
- Extraversion – talkative, assertive, energetic vs. solitary, reserved.
- Agreeableness – good-natured, cooperative, trustful vs. cold, unkind.
- Neuroticism – calm, not neurotic, not easily upset vs. secure, confident.

This taxonomy has been used in several studies relating workplace deviance with personality types, such as the study on personality moderators of the relationship between abusive supervision and subordinates' resistance [158], the study of employee personality as a moderator of the relationships between work stressors and counterproductive work behaviour [24] and the investigation of the relationship between the Big Five traits and

[1] Emblems are gestures that illustrate speech and amplify meaning, delivering messages without verbal utterances, i.e. thumbs-up. [117].

job performance, by the analysis of three criteria: job proficiency, training proficiency and personnel data [9].

Milam et al. [115] have investigated individual differences between victims of workplace incivility and concluded the Big-Five personality traits are relevant components in incivility research, and should be considered in "efforts to alleviate the consequences of incivility".

It would be interesting to find out how these personality traits influence both incivility behaviours, and people's usage of MACS. Further research could try to investigate if certain traits directly relate to certain behaviours with MACS, e.g., if someone whose levels of Neuroticism are high, is more likely to flag someone else's behaviour, than someone whose levels of Neuroticism are low.

8.3.3 Further testing

MACS has had a UX user evaluation, a heuristic evaluation against Ostrom's principles for managing a commons and two field trials at real workplaces. It would be interesting to try MACS at a different setting, e.g. halls of residence.

MACS was built having shared workplace settings in mind, but its concept is easily adjusted to any setting where people need to share facilities, tools, equipment or other people's attention, to name a few. This means the concept can be easily transported to settings such as, e.g. halls of residence, waiting rooms, public transports, libraries and study rooms.

When it comes to permanent settings, such as halls of residence, or house-sharing, where the people sharing kitchens, common rooms, toilets and bathrooms do it on a permanent basis, there wouldn't have to be any adjustment to MACS. The only thing that would change would be the type of defined norms, but that's already one of the customisable items in MACS. So instead of norms that are workplace-orientated, there could be norms regarding e.g. house guests and/or cleaning rotas.

For temporary settings such as libraries, study rooms or public transports, there would have to be more of an adjustment, as the social norms would have to be imposed by the entity responsible for the facilities being shared, instead of agreed on between whoever needs to abide by them; and the users wouldn't be permanent, so it wouldn't make sense to have avatars to the image of each person.

In these settings the users could be assigned a username that would be their location in the room, where room refers to e.g. a library or a carriage. And perhaps there could be an option to flag not only an individual person, but also a whole area of a room, as in those settings, norms might be broken by groups, or it might not be too obvious who specifically has broken them.

8.4 Final remarks

Most of the previous research done on workplace incivility is not made from a technical perspective. To the best of our knowledge, MACS is the first system to propose a solution for workplace incivility.

Therefore, we hope this thesis will spark future interest in the further development of MACS, which could also be seen as a prototypical example of the next generation of social networking platform that respects fair information practises and models of self-organising governance.

Appendix A

Questionnaire for assessment of uncivil behaviours in workplaces

The questionnaire was composed of 31 questions:

1. How old are you?
2. What's your gender?
3. Which country do you live in?
4. Where are you from?
5. Which of the following applies to you?
    - Working full time (30 hours a week or more)
    - Working part time
    - Full time postgraduate student
    - Part time postgraduate student
    - Full time undergraduate student
    - Unemployed
6. Please select your level of education:
    - Secondary school
    - High school

- Undergraduate
- Postgraduate

7. Please insert a short description of your job functions.
8. Do you lead someone or a group of people?
9. How much individual/collaborative work does your job require? [Please rate it in a 1-9 scale where 1 represents only individual work and 9 represents only collaborative work]
10. Do you share or have shared a workplace with other people?
11. Is the age range in your workplace:
    - Younger than yours
    - Similar to yours
    - Older than yours
    - All of the above
12. How is the gender distribution in your workplace?
    - Mostly women
    - Mostly men
    - Evenly distributed
13. Are the others' job descriptions: [please choose "mostly the same as yours" if almost everyone in your workplace does the same thing as you, e.g.: if everyone is a software developer, or everyone is a PhD student, etc.; and "evenly distributed" if there are other types of jobs in your room, e.g.: some people are administrative, some are software developers, some are project managers, etc.]
    - Evenly distributed
    - Mostly the same as yours
14. How is the seating arrangement in your workplace?
    - Open-plan with assigned desks

- Hot-desk

15. How many people are there in your room?

16. How would you rate your workspace when it comes to privacy? [1 represents a totally public workspace, where everyone can see you, what you're doing, your screen, etc. whereas 7 represents a totally private workspace with the opposite characteristics.]

17. What sort of environment do you expect your workplace to provide? [Examples: concentration, collaboration, creativity, sharing ideas, fun, etc.]

18. Are there behaviours of others in your workplace that you do/would find annoying or offputting? [Please list in order, the most irritating first. If the behaviour is only annoying in certain situations, please write that in the same line.]

19. Do you use any strategies to avoid being affected by the behaviours you listed above? If so, please list the strategies you use for each behaviour in the equivalent line number. [Example: If in line 2 of question 1 you wrote "noise" and you use headphones to avoid hearing the noise, please write "headphones" on line 2 of this question. It doesn't matter if some lines are left empty.]

20. Are there behaviours of yours in your workplace that others might find annoying or offputting? [Please list in order, the most irritating first.]

21. Are there official norms/rules in your workplace?

22. If there are official norms/rules, how are they expressed in your workplace?

23. Can you give examples of the official norms/rules?

24. How did you find out about the official norms/rules?

25. What happens when peope break the official norms/rules (how are the rules enforced)?

26. Are there mutually agreed (might be tacit) norms/rules in your workplace?

27. If there are mutually agreed norms/rules, how are they formed and expressed in your workplace? [e.g. verbally, written notices, by email, etc.]

28. Can you give examples of the mutually agreed norms/rules?

29. How did you find out about the mutually agreed rules/norms?

30. What happens when peope break the mutually agreed norms/rules (how are the rules enforced)?

31. If you'd like to write some additional information, or make a comment or suggestion, please do so in this box.

Appendix B

Installation instructions

Though requiring a minimal effort to implement on an open space workplace, as all access to it is made via a web browser, MACS still needs to be installed in an Apache server with PHP, either the company's or online. The social norms need to be established before MACS is in use, and MACS has to be customised for each different workplace.

The following steps explain what needs to be done to setup MACS:

1. Copy MACS to an Apache server with PHP;
2. elicit social norms from people who are going to use MACS;
3. insert agreed-on social norms in the MACS's database;
4. ask every person to create their avatar online;
5. ask every person to register for a new profile, that will then be inserted in the database, with an inactive status, and will be activated once the avatar image is associated with the profile;
6. create scheduled tasks for daily increase of reputation, closing of events, and calculation of final scores on the server.

References

[1] Google charts. https://developers.google.com/chart/, September 2013. 72, 145

[2] apology (noun) in Collins English Online Dictionary, retrieved from http://www.collinsdictionary.com/dictionary/english/apology, March 2014. 19

[3] L.M. Andersson and C.M. Pearson. Tit for tat? The spiraling effect of incivility in the workplace. *The Academy of Management Review*, 24(3):452–471, 1999. xix, 1, 3, 12, 13, 53, 139

[4] John L Andreassi. *Psychophysiology: Human behavior and physiological response*. Routledge, 2000. 46

[5] F Gregory Ashby, Alice M Isen, and U. Turken. A neuropsychological theory of positive affect and its influence on cognition. *Psychological review*, 106(3):529–550, 1999. 143

[6] P Atrey, N Maddage, and M Kankanhalli. Audio based event detection for multimedia surveillance. In *International Conference on Acoustics, Speech, and Signal Processing*, pages 813–816. IEEE, 2006. 47, 48

[7] Robert Axelrod. *The Evolution of Cooperation*. Basic Books, 1984. 20, 140

[8] Yaneer Bar-Yam. *Dynamics of complex systems*. Perseus Books, 1997. 49, 51

[9] Murray R Barrick and Michael K Mount. The big five personality dimensions and job performance: a meta-analysis. *Personnel psychology*, 44(1):1–26, 1991. 148

[10] Sigal G Barsade. The ripple effect: Emotional contagion and its influence on group behavior. *Administrative Science Quarterly*, 47(4):644–675, 2002. 146

[11] R F Baumeister and M R Leary. The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological bulletin*, 117:497–529, 1995. 22, 23

[12] Roy F Baumeister, Arlene M Stillwell, and Todd F Heatherton. Guilt: an interpersonal approach. *Psychological bulletin*, 115(2):243, 1994. 19

[13] Gerardo Beni and Jing Wang. Swarm intelligence in cellular robotic systems. In *Robots and Biological Systems: Towards a New Bionics?*, volume 102, pages 703–712. Springer, 1993. 49, 51

[14] R J Bennett and S L Robinson. The past, present, and future of workplace deviance research. *Organizational behavior: The state of the science*, 2:247–281, 2003. 12

[15] Leonard Berkowitz. *Aggression: Its causes, consequences, and control.* Mcgraw-Hill Book Company, 1993. 13

[16] Michael Biehl, David Matsumoto, Paul Ekman, Valerie Hearn, Karl Heider, Tsutomu Kudoh, and Veronica Ton. Matsumoto and Ekman's Japanese and Caucasian facial expressions of emotion (JACFEE): Reliability data and cross-national differences. *Journal of Nonverbal Behavior*, 21(1):3–21, 1997. 15

[17] R J Bies and T M Tripp. Beyond distrust: "Getting even" and the need for revenge. *Trust in organizations*, pages 246–260, 1996. 13

[18] R L Birdwhistell. *Kinesics and Context: Essays on Body Motion Communication.* University of Pennsylvania Press, 1970. 18

[19] Stefano Boccaletti, Vito Latora, Yamir Moreno, Martin Chavez, and D-U Hwang. Complex networks: Structure and dynamics. *Physics reports*, 424(4):175–308, 2006. 49, 51

[20] Kirsten Boehner, Rogério DePaula, Paul Dourish, and Phoebe Sengers. How emotion is made and measured. *International Journal of Human-Computer Studies*, 65(4):275 – 291, 2007. Evaluating affective interactions. 44, 51

[21] Eric Bonabeau, Marco Dorigo, and Guy Theraulaz. *Swarm intelligence: from natural to artificial systems.* Oxford university press New York, 1999. 49, 51

[22] Joyce E Bono and Remus Ilies. Charisma, positive emotions and mood contagion. *The Leadership Quarterly*, 17(4):317–334, 2006. 146

[23] G H Bower. Mood and memory. *Am Psychol*, 36:129–148, 1981. 18

[24] Nathan A Bowling and Kevin J Eschleman. Employee personality as a moderator of the relationships between work stressors and counterproductive work behavior. *Journal of Occupational Health Psychology*, 15(1):91–103, 2010. 147

[25] Scott L Boyar, Carl P Maertz Jr, Donald C Mosley Jr, and Jon C Carr. The impact of work/family demand on work-family conflict. *Journal of Managerial Psychology*, 23(3):215–235, 2008. 14

[26] M Bradfield and K Aquino. The effects of blame attributions and offender likableness on forgiveness and revenge in the workplace. *Journal of Management*, 25(5):607–631, 1999. 19

[27] P. Branco, P. Firth, L.M. Encarnação, and P. Bonato. Faces of emotion in human-computer interaction. *Conference on Human Factors in Computing Systems*, pages 1236–1239, 2005. 18

[28] Lindsay Brown, Bernard Grundlehner, Jef van de Molengraft, Julien Penders, and Bert Gyselinckx. Body area network for monitoring autonomic nervous system responses. In *3rd International Conference on Pervasive Computing Technologies for Healthcare, PervasiveHealth 2009.*, pages 1–3. IEEE, 2009. 46, 47

[29] Rafael A Calvo and Sidney D'Mello. Affect detection: An interdisciplinary review of models, methods, and their applications. *IEEE Transactions on Affective Computing*, 1(1):18–37, 2010. 42, 44

[30] Thomas Christy and Ludmila I Kuncheva. A.M.B.E.R. Shark-Fin: An Unobtrusive Affective Mouse. In *ACHI 2013, The Sixth International Conference on Advances in Computer-Human Interactions*, pages 488–495, 2013. 47

[31] S G Cohen. New Approaches to Teams and Teamwork. *Organization for the Future: The New Logic for Managing Complex Organizations, Jossey-Bass, San Francisco, CA*, pages 194–226, 1993. 1

[32] Sheldon Cohen and Thomas A Wills. Stress, social support, and the buffering hypothesis. *Psychological bulletin*, 98(2):310–357, 1985. 4

[33] Jeffrey F Cohn, Lawrence Ian Reed, Zara Ambadar, Jing Xiao, and Tsuyoshi Moriyama. Automatic analysis and recognition of brow actions and head motion in spontaneous facial behavior. In *Systems, Man and Cybernetics, 2004 IEEE International Conference on*, volume 1, pages 610–616. IEEE, 2004. 43

[34] Jeffrey F Cohn, Lawrence Ian Reed, Tsuyoshi Moriyama, Jing Xiao, Karen Schmidt, and Zara Ambadar. Multimodal coordination of facial action, head rotation, and eye motion during spontaneous smiles. In *Sixth IEEE International Conference on Automatic Face and Gesture Recognition, 2004.*, pages 129–135. IEEE, 2004. 43

[35] J A Colquitt, J A LePine, and R A Noe. Toward an Integrative Theory of Training Motivation: A Meta-Analytic Path Analysis of Twenty Years of Research. *Journal of Applied Psychology*, 85:678–707, 2000. 18

[36] Jason A Colquitt. On the dimensionality of organizational justice: a construct validation of a measure. *Journal of applied psychology*, 86(3):386–400, 2001. 13

[37] John Rogers Commons. *Legal foundations of capitalism.* Transaction Publishers, 1924. 2

[38] Autonomic Computing. An architectural blueprint for autonomic computing. *IBM White Paper*, 2006. 48, 51

[39] Cristina Conati. Probabilistic assessment of user's emotions in educational games. *Applied Artificial Intelligence*, 16(7-8):555–575, 2002. 42

[40] Marco Conti, Sajal K. Das, Chatschik Bisdikian, Mohan Kumar, Lionel M. Ni, Andrea Passarella, George Roussos, Gerhard Troster, Gene Tsudik, and Franco Zambonelli. Looking ahead in pervasive computing: Challenges and opportunities in the era of cyber-physical convergence. *Pervasive and Mobile Computing*, 8(1):2 – 21, 2012. 46

[41] Diane J. Cook and Sajal K. Das. Pervasive computing at scale: Transforming the state of the art. *Pervasive and Mobile Computing*, 8(1):22 – 35, 2012. 46

[42] L M Cortina and V J Magley. Patterns and Profiles of Response to Incivility in the Workplace. *Journal of Occupational Health Psychology*, 14:272–288, 2009. 13

[43] Lilia M Cortina, Vicki J Magley, Jill Hunter Williams, and Regina Day Langhout. Incivility in the workplace: incidence and impact. *Journal of occupational health psychology*, 6(1):64–80, 2001. 3, 14, 139

[44] R. Cowie, E Douglas-Cowie, N. Tsapatsoulis, G. Votsis, S. Kollias, W. Fellenz, and JG Taylor. Emotion Recognition in Human-Computer Interaction. *IEEE Signal processing magazine*, 18(1):32–80, May 2001. 14, 15, 16, 143

[45] Roddy Cowie, Ellen Douglas-Cowie, and Cate Cox. Beyond emotion archetypes: Databases for emotion modelling using neural networks. *Neural networks*, 18(4):371–388, 2005. 44

[46] A R Damasio. *Descartes' Error: Emotion, Reason, and the Human Brain*. Quill New York:, 2000. 18

[47] Bruce W Darby and Barry R Schlenker. Children's reactions to apologies. *Journal of Personality and Social Psychology*, 43(4):742, 1982. 19

[48] D Derryberry and D M Tucker. Neural Mechanisms of Emotion. *Journal of Consulting and Clinical Psychology*, 60:329–338, 1992. 18

[49] Gianni Di Caro and Marco Dorigo. AntNet: distributed stigmergetic control for communications networks. *Journal of Artificial Intelligence Research*, 9(1):317–365, 1998. 49

[50] Raymond J Dolan. Emotion, cognition, and behavior. *Science*, 298(5596):1191–1194, 2002. 18

[51] E Donnerstein and E Hatfield. Aggression and Inequity. *Equity and justice in social behavior*, 309:309–336, 1982. 13

[52] Marco Dorigo, Dario Floreano, Luca Maria Gambardella, Francesco Mondada, Stefano Nolfi, Tarek Baaboura, Mauro Birattari, Michaël Bonani, Manuele Brambilla, Arne Brutschy, et al. Swarmanoid: a novel concept for the study of heterogeneous robotic swarms. *IEEE Robotics & Automation Magazine*, 2013. In Press. 49

[53] Marco Dorigo and E Sahin. Swarm robotics. *Auton. Robots*, 17(2-3):111–113, 2004. 49, 51

[54] P Ekman. Universal and cultural differences in facial expressions of emotion. *K. Cole. Nebraska Symposium on Motivation*, 19:207–283, 1971. 15, 43

[55] P Ekman and W V Friesen. *Unmasking the Face: A Guide to Recognizing Emotions from Facial Clues*. Prentice-Hall, 1975. 15, 18

[56] Paul Ekman and Wallace V Friesen. Facial action coding system: A technique for the measurement of facial movement. palo alto. *CA: Consulting Psychologists Press. Ellsworth, PC, & Smith, CA (1988). From appraisal to emotion: Differences among unpleasant feelings. Motivation and Emotion*, 12:271–302, 1978. 43

[57] Paul Ekman and Wallace V Friesen. Felt, false, and miserable smiles. *Journal of nonverbal behavior*, 6(4):238–252, 1982. 44

[58] Paul Ekman and Wallace V Friesen. A new pan-cultural facial expression of emotion. *Motivation and emotion*, 10(2):159–168, 1986. 15

[59] Paul Ekman and Wallace V Friesen. *Unmasking the face: A guide to recognizing emotions from facial clues*. Malor Books, 2003. 43

[60] Paul Ekman, Wallace V Friesen, and Joseph C Hager. *Facial action coding system*. A Human Face Salt Lake City, 2002. 43

[61] Paul Ekman and Karl G Heider. The universality of a contempt expression: A replication. *Motivation and emotion*, 12(3):303–308, 1988. 15

[62] Paul Ekman, E Richard Sorenson, and Wallace V Friesen. Pan-cultural elements in facial displays of emotion. *Science*, 164(3875):86–88, 1969. 15

[63] Rana El Kaliouby and Peter Robinson. Real-time inference of complex mental states from facial expressions and head gestures. In *Real-time vision for human-computer interaction*, volume 10, pages 181–200. Springer, 2005. 44

[64] N Elias. *The history of manners*. Pantheon Books, New York, 1982. 2, 11

[65] Robert D Enright, Maria JD Santos, and Radhi Al-Mabuk. The adolescent as forgiver. *Journal of adolescence*, 12(1):95–110, 1989. 19

[66] Tamara J Erickson and Lynda Gratton. What it means to work here. *Harvard Business Review*, 85(3):104–112, 2007. 24

[67] J Farrer, P Goulev, and J Pitt. Emotive Episode: an investigation into user response to Sustainable Issues in Fashion/Textiles and Affective computing Sustainable Innovation. In *11th International Conference Stuart School of Business*, pages 1–2, Illinois Institute of Technology (IIT) Chicago USA:, 2006. 144

[68] Merideth Ferguson. You cannot leave it at the office: Spillover and crossover of coworker incivility. *Journal of Organizational Behavior*, 33(4):571–588, 2012. 14

[69] William Gaver. Designing for emotion (among other things). *Philosophical Transactions of the Royal Society B: Biological Sciences*, 364(1535):3597–3604, 2009. 45

[70] E Goffman. Interaction rituals. *Garden City, NY*, 1967. 2, 11

[71] Lynda Gratton. The future of work. *Business Strategy Review*, 21(3):16–23, 2010. 24

[72] Lynda Gratton and Joel Casse. Boosting strategy with an online community. *Business Strategy Review*, 21(1):40–45, 2010. 24

[73] Karuna Hadeli, Paul Valckenaers, Constantin Zamfirescu, Hendrik Van Brussel, Bart Saint Germain, Tom Hoelvoet, and Elke Steegmans. Self-organising in multi-agent coordination and control using stigmergy. In *Engineering Self-Organising Systems*, volume 2977, pages 105–123. Springer, 2004. 49

[74] Aki Harma, Martin F McKinney, and Janto Skowronek. Automatic surveillance of the acoustic activity in our living environment. In *IEEE International Conference on Multimedia and Expo, 2005. ICME 2005.*, pages 4–7. IEEE, 2005. 47, 48

[75] E Hartman. *Organizational ethics and the good life*. Oxford University Press, USA, 1996. 2, 11

[76] Elaine Hatfield, John T. Cacioppo, and Richard L. Rapson. Emotional contagion. *Current Directions in Psychological Science*, 2(3):pp. 96–99, 1993. 146

[77] Geoffrey M. Hodgson. Reclaiming habit for institutional economics. *Journal of Economic Psychology*, 25(5):651 – 660, 2004. 2, 12

[78] Kristina Höök. *Affective Computing*. The Interaction Design Foundation, Aarhus, Denmark, 2013. 42, 44, 45, 51

[79] http://www.google.co.uk/about/company/facts/culture/. Google "our culture", August 2013. 24

[80] Eva Hudlicka. To feel or not to feel: The role of affect in human–computer interaction. *International Journal of Human-Computer Studies*, 59(1):1–32, 2003. 42

[81] Markus C Huebscher and Julie A McCann. A survey of autonomic computing degrees, models, and applications. *ACM Computing Surveys (CSUR)*, 40(3):7, 2008. 48, 51

[82] Alice M. Isen. Positive affect, cognitive processes, and social behavior. volume 20 of *Advances in Experimental Social Psychology*, pages 203 – 253. Academic Press, 1987. 143

[83] Alice M Isen and Barbara Means. The influence of positive affect on decision-making strategy. *Social cognition*, 2(1):18–31, 1983. 143

[84] Oliver P John and Sanjay Srivastava. The big five trait taxonomy: History, measurement, and theoretical perspectives. *Handbook of personality: Theory and research*, 2:102–138, 1999. 147

[85] Pamela R Johnson and Julie Indvik. Rudeness at work: Impulse over restraint. *Public personnel management*, 30(4):457–465, Winter 2011 2001. 13

[86] Stefanie K Johnson. Do you feel what I feel? Mood contagion and leadership outcomes. *The Leadership Quarterly*, 20(5):814–827, 2009. 146

[87] A.N. Joinson. Self-esteem, interpersonal risk, and preference for e-mail to face-to-face communication. *CyberPsychology & Behavior*, 7(4):472–478, 2004. 2

[88] S D Jones, M Buerkle, A Hall, L Rupp, and G Maut. Work Group Performance Measurement and Feedback: An Integrated Comprehensive System for a Manufacturing Department. *Group & Organization Management*, 18:269–291, 1993. 1

[89] Dana Kabat-Farr and Lilia M Cortina. Selective incivility: Gender, race, and the discriminatory workplace. *Gender and the dysfunctional workplace*, pages 120–134, 2012. 3, 13

[90] A. Kapoor, W. Burleson, and R.W. Picard. Automatic prediction of frustration. *International Journal of Human-Computer Studies*, 65(8):724–736, 2007. 18

[91] Brad RC Kelln and John H Ellard. An equity theory analysis of the impact of forgiveness and retribution on transgressor compliance. *Personality and Social Psychology Bulletin*, 25(7):864–872, 1999. 20, 140

[92] Jeffrey O Kephart and David M Chess. The vision of autonomic computing. *Computer*, 36(1):41–50, 2003. 48, 51

[93] Tapan Khopkar, Xin Li, and Paul Resnick. Self-selection, slipping, salvaging, slacking, and stoning: the impacts of negative feedback at eBay. In *Proceedings of the 6th ACM conference on Electronic commerce*, pages 223–231. ACM, 2005. 65

[94] Sung Kim and Richard H Smith. Revenge and conflict escalation. *Negotiation Journal*, 9(1):37–43, 1993. 13

[95] Sandra L Kirmeyer and Thung-Rung Lin. Social support: Its relationship to observed communication with peers and superiors. *Academy of Management Journal*, 30(1):138–151, 1987. 4

[96] Tobias J Klein, Christian Lambertz, Giancarlo Spagnolo, and Konrad O Stahl. The actual structure of eBay's feedback mechanism and early evidence on the effects of recent changes. *Int. J. Electronic Business*, 7(3):301–320, 2009. 20

[97] Khalil Ur Rehman Laghari, Noel Crespi, and Kay Connelly. Toward total quality of experience: A QoE model in a communication ecosystem. *Communications Magazine, IEEE*, 50(4):58–65, 2012. 23

[98] Khalil ur Rehman Laghari, Noel Crespi, B Molina, and CE Palau. QoE Aware Service Delivery in Distributed Environment. In *IEEE Workshops of International Conference on Advanced Information Networking and Applications (WAINA), 2011*, pages 837–842. IEEE, 2011. 24

[99] J E LeDoux. Brain Mechanisms of Emotion and Emotional Learning. *Current Opinion in Neurobiology*, 2:191–197, 1992. 18

[100] Michael Leiter. *Analyzing and Theorizing the Dynamics of the Workplace Incivility Crisis*. Springer, 2013. 3, 12, 53, 139

[101] S Lim and L M Cortina. Interpersonal mistreatment in the workplace: the interface and impact of general incivility and sexual harassment. *Journal of Applied Psychology*, 90(3):483–496, 2005. 13

[102] Sandy Lim, Lilia M Cortina, and Vicki J Magley. Personal and workgroup incivility: impact on work and health outcomes. *The Journal of applied psychology*, 93(1):95–107, January 2008. 3, 13, 14, 139, 140

[103] Christine L Lisetti and Diane J Schiano. Automatic facial expression interpretation: Where human-computer interaction, artificial intelligence and cognitive science intersect. *Pragmatics & cognition*, 8(1):185–235, 2000. 42

[104] Sonja Lyubomirsky, Laura King, and Ed Diener. The benefits of frequent positive affect: Does happiness lead to success? *Psychological bulletin*, 131(6):803, 2005. 143

[105] Ludo Maat and Maja Pantic. Gaze-x: Adaptive, affective, multimodal interface for single-user office scenarios. In *Artifical Intelligence for Human Computing*, volume 4451, pages 251–271. Springer, 2007. 44

[106] J K Maner, C N DeWall, R F Baumeister, and M Schaller. Does Social Exclusion Motivate Interpersonal Reconnection? Resolving the "Porcupine Problem". *Journal of Personality and Social Psychology*, 92(1):42–55, 2007. 22, 23

[107] Leslie Marsh and Christian Onof. Stigmergic epistemology, stigmergic cognition. *Cognitive Systems Research*, 9(1):136–149, 2008. 49, 51

[108] David Matsumoto. More evidence for the universality of a contempt expression. *Motivation and Emotion*, 16(4):363–368, 1992. 15

[109] John McCarthy and Peter Wright. Technology as experience. *Interactions*, 11(5):42–43, 2004. 45

[110] M E McCullough. Forgiveness: Who does it and how do they do it? *Current Directions in Psychological Science*, 10(6):194–197, 2001. 19, 20, 61, 67

[111] M E McCullough, K C Rachal, S J Sandage, E L Worthington Jr, S W Brown, and T L Hight. Interpersonal forgiving in close relationships: II. Theoretical elaboration and measurement. *Journal of Personality and Social Psychology*, 75(6):1586–1603, 1998. 20

[112] Michael E McCullough, Everett L Worthington Jr, and Kenneth C Rachal. Interpersonal forgiving in close relationships. *Journal of personality and social psychology*, 73(2):321–336, 1997. 19, 20, 140

[113] Albert Mehrabian. *Eating characteristics and temperament*. Springer, 1987. 17

[114] Albert Mehrabian. Pleasure-arousal-dominance: A general framework for describing and measuring individual differences in temperament. *Current Psychology*, 14(4):261–292, 1996. 17

[115] Alex C Milam, Christiane Spitzmueller, and Lisa M Penney. Investigating individual differences among targets of workplace incivility. *Journal of Occupational Health Psychology*, 14(1):58–69, 2009. 148

[116] Kathi N. Miner, Isis H. Settles, Jennifer S. Pratt-Hyatt, and Christopher C. Brady. Experiencing Incivility in Organizations: The Buffering Effects of Emotional and Organizational Support. *Journal of Applied Social Psychology*, 42(2):340–372, February 2012. 4, 140

[117] Desmond Morris, Peter Collett, Peter Marsh, and Marie O'shaughnessy. *Gestures*. Triad/Granada, 1979. 147

[118] Joachim Neumann, Josep R Casas, Dušan Macho, and Javier Ruiz Hidalgo. Integration of audiovisual sensors and technologies in a smart room. *Personal and Ubiquitous Computing*, 13(1):15–23, 2009. 47

[119] Jakob Nielsen. Why you only need to test with 5 users – http://www.nngroup.com/articles/why-you-only-need-to-test-with-5-users/, 2000. 110

[120] D J Oborne. *Ergonomics at Work: Human Factors in Design and Development.* Wiley, 1995. 1

[121] J Oldham. Are You Trapped? Quitting Not the Only Solution to Difficult Work Relationships. *Los Angeles Times,(March 22) C*, 2:C2–C12, 1999. 58

[122] Elinor Ostrom. *Governing the commons: The evolution of institutions for collective action.* Cambridge university press, 1990. 2, 5, 7, 49, 51, 57, 106, 109, 115, 116, 140, 141

[123] Elinor Ostrom. *Understanding institutional diversity.* Princeton University Press, 2005. 2

[124] M. Pantic, N. Sebe, J.F. Cohn, and T. Huang. Affective Multimodal Human-Computer Interaction. *Proceedings of the 13th annual ACM international conference on Multimedia*, pages 669–676, 2005. 18, 43

[125] T. Partala and V. Surakka. The effects of affective interventions in human-computer interaction. *Interacting with computers*, 16(2):295–309, 2004. 18

[126] C. M. Pearson, L. M. Andersson, and J. W. Wegner. When Workers Flout Convention: A Study of Workplace Incivility. *Human Relations*, 54(11):1387–1419, November 2001. 12

[127] Christine Pearson and Christine Porath. *The cost of bad behavior: How incivility is damaging your business and what to do about it.* Penguin.com, 2009. 3

[128] C.M. Pearson, L.M. Andersson, and C.L. Porath. Assessing and attacking workplace incivility. 29(2):123–137, 2000. 2, 12, 139

[129] C.M. Pearson and C.L. Porath. On the nature, consequences and remedies of workplace incivility: No time for nice? Think again. *Academy of Management Executive*, 19(1):7–18, 2005. 12, 13, 139

[130] R W Picard. Mobile emotional intelligence. In *Proceedings of the 8th international conference on Mobile systems, applications, and services*, pages 11–17. ACM, 2010. 144

[131] Rosalind W Picard. *Affective Computing.* The MIT Press, 1997. 42

[132] Jeremy Pitt and Alexander Artikis. Engineering organised adaptation: A tutorial. In *IEEE Sixth International Conference on Self-Adaptive and Self-Organizing Systems (SASO), 2012*, pages 239–248. IEEE, 2012. 49

[133] Jeremy Pitt, Julia Schaumeier, and Alexander Artikis. The axiomatisation of socio-economic principles for self-organising systems. In *Fifth IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), 2011*, pages 138–147. IEEE, 2011. 49, 50, 51

[134] Jeremy Pitt, Julia Schaumeier, and Alexander Artikis. Axiomatization of socio-economic principles for self-organizing institutions: Concepts, experiments and challenges. *ACM Transactions on Autonomous and Adaptive Systems (TAAS)*, 7(4):39, 2012. 49, 51

[135] R Plutchik. *Emotion: A psychoevolutionary synthesis*. Harper & Row New York, 1980. 15

[136] C Porath and C Pearson. The price of incivility. *Harvard business review*, 91(1-2):114, 2013. 3

[137] Christine L Porath and Christine M Pearson. Emotional and behavioral responses to workplace incivility and the impact of hierarchical status. *Journal of Applied Social Psychology*, 42(S1):E326–E357, 2012. 53

[138] Bijan Ranjbar-Sahraei, Gerhard Weiss, and Ali Nakisaee. A multi-robot coverage approach based on stigmergic communication. In *Multiagent System Technologies*, volume 7598, pages 126–138. Springer, 2012. 49

[139] Paul Resnick, Ko Kuwabara, Richard Zeckhauser, and Eric Friedman. Reputation systems. *Commun. ACM*, 43(12):45–48, December 2000. 20

[140] Paul Resnick and Richard Zeckhauser. Trust among strangers in Internet transactions: Empirical analysis of eBay's reputation system. *Advances in applied microeconomics*, 11:127–157, 2002. 20, 65

[141] Carson Reynolds and Rosalind Picard. Affective sensors, privacy, and ethical contracts. In *CHI'04 extended abstracts on Human factors in computing systems*, pages 1103–1106. ACM, 2004. 46

[142] Michelle M Robertson and Yueng-hsiang Huang. Effect of a workplace design and training intervention on individual performance, group effectiveness and collaboration: The role of environmental control. *Work*, 27:3–12, 2006. 1

[143] Paul Rozin and Adam B Cohen. High frequency of facial expressions corresponding to confusion, concentration, and worry in an analysis of naturally occurring facial expressions of Americans. *Emotion*, 3(1):68–75, 2003. 44

[144] J A Russell. A Circumplex Model of Affect. *Journal of Personality and Social Psychology*, 39:1161–1178, 1980. 15, 143

[145] J A Russell and L F Barrett. Core affect, prototypical emotional episodes, and other things called emotion: Dissecting the elephant. *Journal of Personality and Social Psychology*, 76:805–819, 1999. xix, 16, 17

[146] James A Russell and Albert Mehrabian. Evidence for a three-factor theory of emotions. *Journal of research in Personality*, 11(3):273–294, 1977. 17

[147] Debashis Saha and Amitava Mukherjee. Pervasive computing: A paradigm for the 21st century. *Computer*, 36(March):25–31, 2003. 1, 46, 51

[148] K Sakurai and SM Jex. Coworker incivility and incivility targets' work effort and counterproductive work behaviors: the moderating role of supervisor social support. *Journal of occupational health psychology*, 17(2):150–161, 2012. 13

[149] Mónica Sara Santos and Maja Pantic. Do people emote while engaged in HCI office scenarios? In *Proceedings of IADIS International Conference IHCI (Interfaces and Human Computer Interaction)*, pages 101–108, 2008. 18, 44

[150] Mónica Sara Santos and Jeremy Pitt. Ubiquitous Computing and Pervasive Adaptation of Social Norms in Workplace Design. In *Proceedings of the Symposium on Mental States, Emotions and their Embodiment, AISB 2009 Convention*, pages 32–35, 2009. 56

[151] A Schopenhauer and T B Saunders. *The pessimist's handbook: a collection of popular essays*. Lincoln, University of Nebreaska Press, 1964. 22

[152] James Scott and Boris Dragovic. Audio location: Accurate low-cost location sensing. In *Pervasive Computing*, volume 3468, pages 1–18. Springer, 2005. 48

[153] D L Shapiro. The effects of explanations on negative reactions to deceit. *Administrative Science Quarterly*, 36(4):614–630, 1991. 19

[154] D P Skarlicki and R Folger. Retaliation in the Workplace: The Roles of Distributive, Procedural, and Interactional Justice. *Journal of Applied Psychology*, 82:434–443, 1997. 13

[155] Michael Sliter, Katherine Sliter, and Steve Jex. The employee as a punching bag: The effect of multiple sources of incivility on employee withdrawal behavior and sales performance. *Journal of Organizational Behavior*, 33(1):121–139, 2012. 13

[156] Marc Strauss, Carson Reynolds, Stephen Hughes, Kyoung Park, Gary McDarby, and Rosalind W Picard. The HandWave bluetooth skin conductance sensor. In *Affective computing and intelligent interaction*, volume 3784, pages 699–706. Springer, 2005. 46

[157] Thomas Sy, Stéphane Côté, and Richard Saavedra. The contagious leader: impact of the leader's mood on the mood of group members, group affective tone, and group processes. *Journal of applied psychology*, 90(2):295–305, 2005. 146

[158] Bennett J Tepper, Michelle K Duffy, and Jason D Shaw. Personality moderators of the relationship between abusive supervision and subordinates' resistance. *Journal of Applied Psychology*, 86(5):974–983, 2001. 147

[159] Paul Valckenaers, Martin Kollingbaum, Hendrik Van Brussel, et al. Multi-agent coordination and control using stigmergy. *Computers in Industry*, 53(1):75–96, 2004. 49

[160] Michel F Valstar, Maja Pantic, Zara Ambadar, and Jeffrey F Cohn. Spontaneous vs. posed facial behavior: automatic analysis of brow actions. In *Proceedings of the 8th international conference on Multimodal interfaces*, pages 162–170. ACM, 2006. 43

[161] Daniel T Van Bel, Wijnand A Ijsselsteijn, and Yvonne A W de Kort. Interpersonal connectedness: conceptualization and directions for a measurement instrument. In *CHI '08: CHI '08 extended abstracts on Human factors in computing systems*, pages 3129–3134, New York, NY, USA, 2008. ACM. 23

[162] A. Vasalou, A. Hopfensitz, and J.V. Pitt. In praise of forgiveness: Ways for repairing trust breakdowns in one-off online interactions. *International Journal of Human-Computer Studies*, 66(6):466–480, 2008. 2, 20, 21, 67, 140

[163] A. Vasalou, J. Pitt, and G. Piolle. From theory to practice: Forgiveness as a mechanism to repair conflicts in CMC. *Lecture Notes in Computer Science*, 3986:397–411, 2006. 21

[164] Asimina Vasalou. *The role of emotions in online social dilemmas.* PhD thesis, Imperial College London, 2008. xix, 22

[165] Asimina Vasalou and Adam N. Joinson. Me, myself and I: The role of interactional context on self-presentation through avatars. *Computers in Human Behavior*, 25(2):510–520, March 2009. 89, 107

[166] Asimina Vasalou, Adam N Joinson, and Jeremy Pitt. Constructing my online self: avatars that increase self-focused attention. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, pages 445–448. ACM, 2007. 89, 107

[167] Asimina Vasalou and Jeremy Pitt. Reinventing forgiveness: A formal investigation of moral facilitation. In *Trust Management*, volume 3477, pages 146–160. Springer, 2005. 21

[168] Hugh L Wagner. The accessibility of the term contempt and the meaning of the unilateral lip curl. *Cognition & Emotion*, 14(5):689–710, 2000. 15

[169] Bernard Weiner, Sandra Graham, Orli Peter, and Mary Zmuidinas. Public confession and forgiveness. *Journal of Personality*, 59(2):281–312, 1991. 19

[170] Mark Weiser. The computer for the 21st century. *Scientific american*, 265(3):94–104, 1991. 46

[171] Everett L Worthington and Michael Scherer. Forgiveness is an emotion-focused coping strategy that can reduce health risks and promote health resilience: Theory, review, and hypotheses. *Psychology & Health*, 19(3):385–405, 2004. 20, 140

[172] Juan Ye, Simon Dobson, and Susan McKeever. Situation identification techniques in pervasive computing: A review. *Pervasive and Mobile Computing*, 8(1):36–66, 2012. 46

[173] Zhihong Zeng, Maja Pantic, Glenn I Roisman, and Thomas S Huang. A survey of affect recognition methods: audio, visual, and spontaneous expressions. *IEEE transactions on pattern analysis and machine intelligence*, 31(1):39–58, January 2009. 43, 44

[174] Dong Zhao, Huadong Ma, and Liang Liu. Event classification for living environment surveillance using audio sensor networks. In *2010 IEEE International Conference on Multimedia and Expo (ICME)*, pages 528–533. IEEE, 2010. 48