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Exploring Emotion Representation to Support Dialogue in Police Training on Child Interviewing

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Abstract. Police officers when dealing with interviewing children have to cope with a complex set of emotions from a vulnerable witness. Triggers for recognising those emotions and how to build rapport are often the basis of learning exercises. However, current training pulls together the full complexity of emotions during role-playing which can be over-whelming and reduce appropriate learning focus. Interestingly a serious game's interface can provide valuable training not because it represents full complex, multimedia interactions but because it can restrict emotional complexity and increase focus during the interactions on key factors for emotional recognition. The focus of this paper is to report on a specific aspect that was explored during the development of a serious game that aims to address the current police-training needs of child interviewing techniques, where the recognition of emotions plays an important role in understanding how to build rapport with children. The review of literature reveals that emotion recognition, through facial expressions, can contribute significantly to the perceived quality of communication. For this study an 'emotions map' was created and tested by 41 participants to be used in the development of a targeted interface design to support the different levels of emotion recognition. The emotions identified were validated with a 70% agreement across experts and non-experts highlighting the innate role of emotion recognition. A discussion is made around the role of emotions and game-based systems to support their identification for work-based training. As part of the graphical development of the Child Interview Stimulator (CIS) we examined different levels of emotional recognition that can be used to support the in-game graphical representation of a child's response during a police interview.

Keywords: Facial expressions · serious games · police interviewing · emotion recognition

1   Introduction

Interviewing vulnerable children and using them as witnesses is a difficult and sometimes challenging issue, especially for new recruits and early career front line police, who may have limited training and real-life experience of interacting with children. Past research within child interviewing has often focused on the controversy around suggestibility and reliability of a child's statement, their vulnerability in the judicial

setting, and a child's perception of the police as an authority figure [1,2,3]. To support police practice in this field there are important 'Achieving Best Practice' (ABP) guidelines provided on how to safeguard children's welfare whilst facilitating the collection of high quality evidence [4,5]. However, all too often police do not adhere to these guidelines when conducting interviews with children [6]. One of the key barriers preventing the adoption of these guidelines is the training of front line police officers, making it difficult for them to develop the necessary skills that can assist them when faced with interviewing a child. In the recent 2015 HMIC report entitled 'In Harm's Way', the specialist training of police in the area of child interviewing skills (especially when taking first statements), was considered ineffective with a reliance on simplistic online training [7]. This has resulted in a police problem with disengagement and simplistic understanding by the police of child interviewing techniques and processes.

This paper documents research into the use of Game-Based Learning (GBL) to support police training and engagement to develop a deeper understanding in child interview training. This is sought through the use of a serious game to focus on specific learning aspects (e.g., rapport and emotional recognition), to support and enhance police tacit experiential knowledge. The result is a serious game, Child Interview Simulator (CIS), which can assist front-line police officers in developing a deeper understanding of effective practices and provides a more engaging mode of the training of early career police officers when they interact with a child. The particular focus of this paper is to research how emotional recognition can be used to support the training within rapport building when police officers interact with a child during an interview.

2   Challenges of Child Interviewing

Child interviewing research evidence suggests that child statements should be taken as early as possible after the alleged offence. Interviewers should encourage children to disclose as much information as possible by using open-ended prompts (e.g., 'Tell me what happened'), as opposed to focused (yes/no) questions [8,9]. Children are capable of providing accurate information about their experiences, but the quality of communication and the types of retrieval methods used need to be carefully considered [10]. Far too often child witnesses are not interviewed by police as their abilities at remembering the events are considered poor. Research has identified various techniques, such as revisiting the context in which the event occurred, or children drawing during interviews to enhance free-recall while avoiding feelings of risk and error [10]. Paine et al. [11] identified that the mode of interaction with children that includes visual prompts can positively impact upon the success of these interviews. Unfortunately, these findings have not effectively been passed through into police practice. Research has revealed that more often suggestive utterances and focused questions were used as a means to obtain accurate information due to limited time and lack of effective training [9],[12].

In policing, practice communication with children can be difficult for police officers, especially for those unfamiliar with dealing with children. Tactic police practices have identified that one of the essential elements in a successful interview is the ability to

build good rapport. The onus is for the front line police officer (who arrives first at the scene), to establish good rapport quickly. This can be very challenging, especially when time maybe limited and there are often other witnesses and distractions to deal with. Furthermore, police officers also have to judge the child's cognitive and language abilities, along with assessing their emotional state [3]. As a result, during initial contact police officers often do not allow appropriate time that is needed for rapport building, and so fail to gain good quality statements from a child.

Both academic research and tacit police knowledge have identified the important need for effective training in how to take the first statement from a child, especially for front-line early career police officers. Training of new recruit police officers within the UK combines an intense initial tutor-lead phase, followed by a 2-year community-based probationary period. Although new recruit police officers are given some training in child-interview procedures there is little time to practice these skills, and the online-training courses are limited and deemed inadequate to develop these skills. It is not until police officers have been practicing for a number of years that they may be selected to attend an intensive 2-3week child interviewing training course that largely consists of role-play. Practice-based learning and training aim to replicate real world interactions to enable a transfer of understanding from the learning activity to real world experiences. For example, inquiry learning suggests learning through doing [13, 14]. Problem-based learning highlights the value of real world problems as a focus for testing learning [15]. Role playing provides a valuable approach to learning through enacting experiences [16]. However, recent findings have identified that often the complexity of real world interactions can distract and reduce the effectiveness of realistic approaches to learning and training [17]. The aim of the CIS serious game is to focus the learners on specific tacit skills that can support them during their 2-year probationary period, prior to attending a more specialist child interviewing course.

3 Representation of Emotions in Games

3.1 Categorizing Emotions

Children, whilst vulnerable have been recognized by the police internationally as witnesses to crime who should not be undervalued and ignored. The ability to assess a child's emotional state during a police interview would be a huge advantage for the interviewer, as they can adapt the interview technique in order to build rapport and aid communication. There are many cues of nonverbal behavior that are used to assist communication. Recognizing and responding to non-verbal behavior is central to building rapport and achieving a successful interview. Communication usually consists of a mix between verbal communication and several types of nonverbal behaviors, such as gestures, body language, tone of voice and facial expression. Sometimes the verbal and nonverbal language conflict with each other, which often results in the nonverbal cues being perceived as being more authentic than the verbal, as these are harder to control [18]. Nonverbal information has been termed as 'leaky' clues, as they can reveal the true feelings or intensions of the speaker [19]. Therefore, it is important for an interviewer to be able to pick up and recognize the nonverbal cues, as this provides insights

in the emotional state of an interviewee, and can have big implications that can either have a positive or negative impact as to how well an interview may progress. While technology cannot replicate the full complexity of human interactions, we argue that this maybe an advantage for training purposes. By restricting these cues during police training we could increase the potential for more effective cognition and internalizing of these tacit interviewing behaviors. Furthermore, by restricting and simplifying the cues it could be argued that this may increase awareness of these factors by those being trained. The face, in particular, allows us to express in visual form our feelings and emotions, and plays an invaluable role in social interactions and communications [20]. For example, facial cues have been argued as the most important behavior to focus research on when developing rapport for those with Asperger's syndrome who have problems recognizing emotions [21].

Facial expressions are the most obvious emotional indicators providing initial indications of how a person is feeling at any given time. The visual nature of emotional expressions makes it a very good method for incorporating nonverbal clues into a game design. The study of emotions has been of great interest to various scientific fields, ranging from psychology and neuroscience, to machine learning and computer vision. Emotions have been widely viewed in psychology as categorical, in that there are certain basic emotions that is governed by individual neural networks [22]. Past researchers have suggested different lists of basic emotions, with Ekman & Friesen [23] being in the forefront in the measuring and validation of facial expression. Their theory is based on the premise that emotional expressions are formed by changes in different facial muscle actions that create emotional patterns that can be recognized as different emotions. Many of these patterns of muscle movements within the face have been coded by Ekman & Friesen [23] to form the basis for the Facial Action Coding System (FACS). A database of over 200 facial images of different expressions were created [24], by breaking expressions down into Action Units (AC). Since then, FACS has become one of the most widely used and validated method of measuring, analyzing and describing facial behavior. In a recent paper by Ekman [25], a survey of experts in emotion related research was conducted to identify the most salient emotions. There was a very high agreement (75-90%) that the top most recognizable emotions were anger, fear, sadness, happiness and disgust. Less salient emotions found were shame, surprise and embarrassment (40-50%), followed by guilt, contempt, love, pain, envy and compassion, being less recognizable. This is reflected in further literature, where the primary 6 emotions (with the addition of surprise) are identified as being the most recognizable, while the secondary emotions (such as guilt, contempt etc.), being considered more difficult to define [26,27].

In contrast, the dimensional *Circumplex Model of Affect* (CMA) theory [22] see emotions organized on a two-dimensional level of *valence* and the intensity of *arousal (activation),* which map emotions onto an *Affective Space Model*, (see **Fig. 5**). Different emotions are understood on each of these two linear dimensions, or varying degrees of valence or arousal. Although the CMA allows for a variety of emotions across a wide spectrum, it does not determine the most (or least) recognizable emotions. We argue, that for police interview training, using the most recognizable emotions (identified by Ekman & Friesen), rather than all the complexities of less salient emotions (provided

by the CMA), is valuable for enhancing awareness of rapport. Whilst role-play training cannot restrict and focus on these issues, the CIS can focus on specific key emotions that are relevant to the game storyline, thus assisting the learner in rapport building.
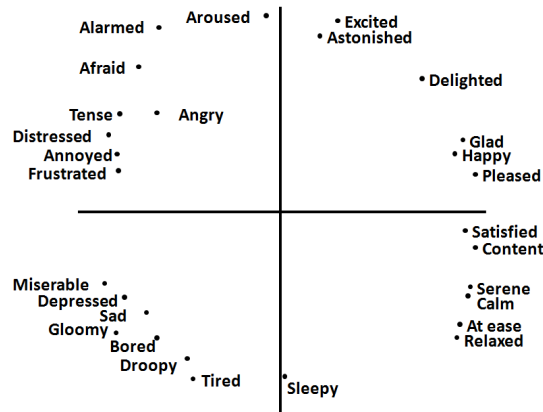
Aroused •   • Excited
Alarmed •   • Astonished

Afraid •   • Delighted

Tense •   • Angry
Distressed •   • Glad
Annoyed •   • Happy
Frustrated •   • Pleased

• Satisfied
• Content

Miserable •   • Serene
Depressed •   Calm
Sad •   • At ease
Gloomy •   • Relaxed
Bored •
Droopy •
• Tired • Sleepy

Fig. 1. A graphical representation of the Circumplex Model of Affect showing the horizontal axis (valence), and the vertical axis (arousal).

It has been argued by facial recognition research [26] that the lack of any contextual information (social situation in which the emotion occurred) and any causal information (events that may have caused the emotion) could increase the effective emotion recognition. Again whilst this may not be a true representation of reality, it does provide a way to focus training and increase its effectiveness. By providing an initial awareness of these cues for the police during training it is argued that this would allow an awareness of these basic emotions before they become over-complex and harder to interpret with situational and emotional intensity. For example, the intensity of the emotion has been identified as providing an impact on its effective identification, with some emotions at full intensity (such as anger and disgust) looking very similar, thus causing confusion [28].

The value for the police to enable a more focused route to training cannot be underestimated. The ability to assess a child's emotional state during the interview would offer a huge advantage for the police interviewer. Providing effective and engaging training in this area can allow the police to adapt their interview technique, to build rapport and aid commination, and ultimately increase their potential to solve crimes and bring perpetrators to justice. Enhancing the tacit skills of early police officers to identify the emotional states of a vulnerable witness will enable them to respond appropriately to their needs.

3.2   Emotion Recognition in Games

Emotions' recognition is a basic social skill and is identified as the ability to recognize the major group of human emotions. It is associated not only with effective peer relationships and social development, but also with children's preparation for learning in a formal setting [29]. Emotions conveyed by facial expressions, gestures, words or

situations contain critical information for the regulation of social interactions. Significant research has been conducted during the last three decades within the field of serious games, in the development of systems that attempt to mimic human cognitive processes by automatically analyzing and interpreting facial expressions. In order to address the challenges related to this particular field of research, facial expression analysis has been distinguished between two main streams: facial affect analysis and facial muscle motion analysis [23],[30]. Most facial expression analysis systems focus on facial expressions to estimate emotion related activities. In addition, many studies have introduced the interpretation of real-life situations based on the correlation of multiple channels, such as both speech and facial expressions [31].

As humans perceive a lot of emotional information through visual communication, several research projects have investigated the different aspects of affect recognition through facial characteristics [29,30], [32,33]. The majority of serious games developed around this scientific field mainly focus on health studies and affect recognition for individuals with Autism Spectrum Disorder (ASD). The use of virtual humans as a way to teach emotion recognition through games enables the contextualization of emotions, as they simulate real conversation without the actual social interaction that people with ASD find difficult [32]. In addition, the review of current literature on emotion recognition in gaming contexts verifies the use of the widely accepted model of Ekman and Friesen [23] which supports the universality of facial expressions (described in previous section).

In the gaming field, the development of embodied conversational agents (ECAs) and talking heads with a focus on accurate gaze targets have been in the center of recent research efforts [34,35,36]. The use of ECAs in different contexts and purposes in games has revealed the importance of facial expressions and non-manual facial signals in speech and language understanding. Consequently, avatars are required to portray at the same time emotion and facial non-manual signals [37]. Furthermore, there is an emergent need for expressive avatars that will mainly contribute to Collaborative Virtual Environments (CVEs). The use of avatars as simple placeholders doesn't contribute to the communication process and it has been proved that even a single expressive behavior that reflects the conversation can contribute significantly to the perceived quality of communication [38].

4   A Serious Game for UK Police Force

The Child Interview Simulator (CIS) consists of a serious game developed to enable and complement current police training practices in the field of child interviewing, targeting mainly new recruits. The CIS simulates a real-life situation that allows the player to be a police officer whose goal is to obtain a first statement from a child that has witnessed an alleged criminal offence, and then conduct an interview. This serious game bases its structure on dialogue mode and utilizes interview types applied in previous games like "Global Conflicts: World Collections" [39].

The game was co-developed with one UK police force with the context being inspired by an actual real life case that formed the backstory to the CIS. A nine-year old

boy is walking on his way back home from school, when he witnesses a man grabbing a lone female from the bushes and attempting to drag her off the common pathway. As the woman screams, the attacker notices the child watching him and in panic, runs away. The gameplay is based on Experimental Learning Theory [40], which uses the learner's experiences in order to facilitate learning. Following Kolb's four stages of learning theory, the player learns about the incident and collects information on the witness through various sources (State 1: Concrete Experience), then reflects on the obtained information (State 2: Reflective Observation), in order to develop his/her own understanding (Stage 3: Abstract Conceptualization), and finally act accordingly by making the correct choices in gameplay (Stage 4: Active Experimentation).

The CIS has two main parts (see **Fig. 2**), the first begins when the police trainee receives a dispatch call about the incident and visits the child at his home in order to take a first response statement. The second part consists of the police trainee conducting an interview in what is known as Achieving Best Evidence (ABE) suite. Although, in reality a trainee will need to have undertaken specialized child interview training to conduct an ABE suite interview with a child; the experience given by engaging in the 2nd part of the CIS will allow them to experience the importance of gathering effective data from the first response interview, and how this may impact on the success of the ABE interview.
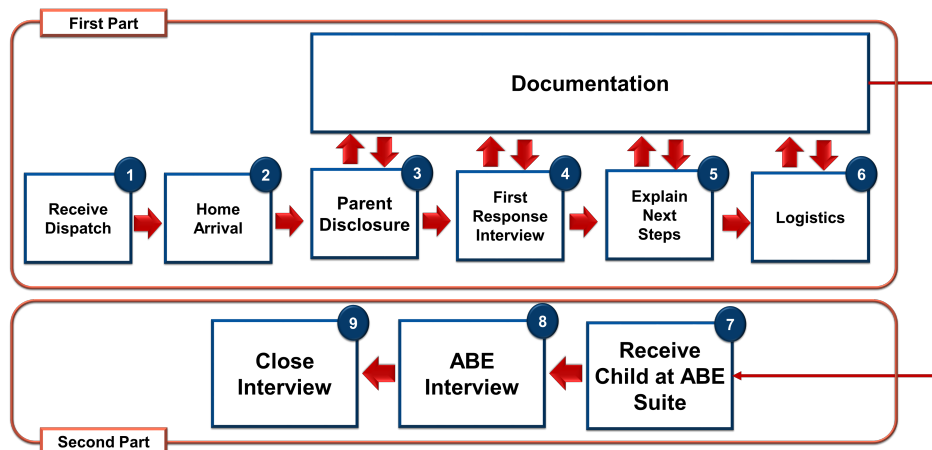

Fig. 2. The Child Interview Simulator (CIS) showing the two parts broken down in episodes

In the first part, the key episodes are the parent disclosure (episode 3) where the police trainee needs to obtain a statement of account from the parent, without the child present, and the first response interview (episode 4) where the police trainee obtains the first account statement of the alleged offence from the child. In the second part, the key episode is documenting the police interview with the child, which is captured on video (episode 8), and used as evidence in court, thus not requiring the child to be present within the judicial court procedure. In all the episodes, it is necessary for the police trainee to engage with the child in verbal communication (see **Fig. 3.** for a snapshot of the dialogue interaction within episode 4). However, the hard challenge to master is the

recognition and interpretation of the non-verbal communication cues, which are complex and difficult to implement in the form of a serious game. The use of 3D was discarded early in the development precisely because believable non-verbal communication would be difficult to support, and consequently 2D was adopted as a credible alternative to representing the emotional state of the characters with whom the police trainee will engage with. To support the trainee further, a 'Rapport bar' was conceived to convey how successful the trainee is in building trust, affinity and empathy with each stakeholder (mother and child). The decision of making rapport visually explicit in the form a gauge (top left corner of **Fig. 3**) was due to the difficulty of capturing the non-verbal subtleties even in 2D.
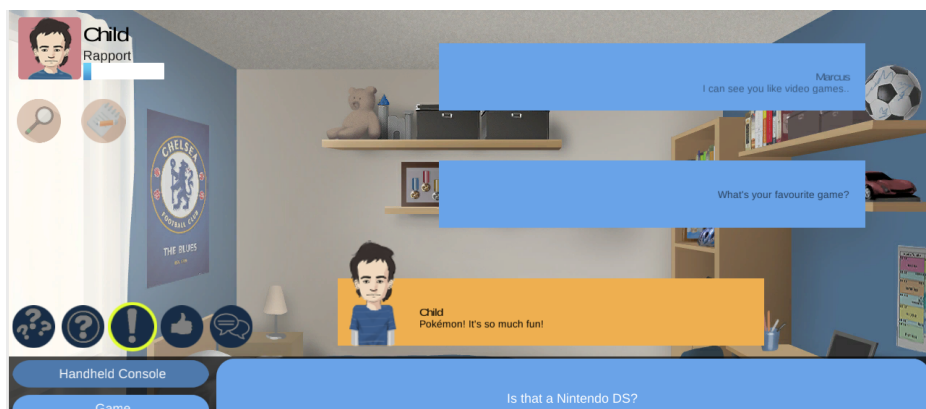

Fig. 3. Partial snapshot of the CIS in the first response interview (episode 4)

The CIS uses the child's facial expression to make explicit the emotional state of the child, and to convey their mood which provides an indication as to how the interview is proceeding. For example, **Fig. 4** illustrates the case when the child changed his emotional state from neutral to angry because the police trainee decided to take by force the gaming device that the child was playing with in order to gain their attention.

To ensure that the emotions are recognizable, a set of facial expressions were generated for the child-witness character and these were tested with different stakeholders, ranging from experienced police officers to interviewing experts. The initial set of 17 facial expressions included a set of basic emotions validated by relevant literature [25], were used within the evaluation test.
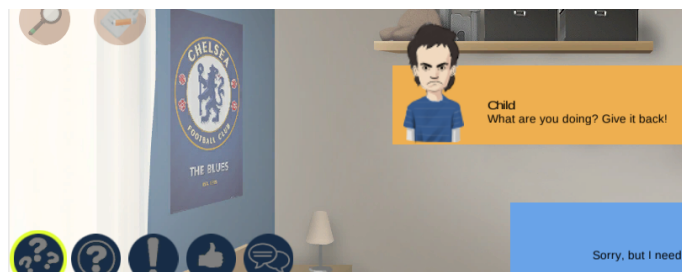

Fig. 4. Partial snapshot of the CIS demonstrating change of child's emotion

The different emotions were organized into an Emotions Map (**Fig. 5**) consisting of eight different branches of emotions. The categorization was done based on the intensity of each emotional state. Consequently, the facial expressions marked in dark blue are the most easily recognizable by people (Level 1) and those marked in light blue are less easily recognizable (Level 2). Following this approach, we formed an Emotions Map consisting of eight pairs of emotions (ranging from more to less intense facial expressions) and a neutral one.
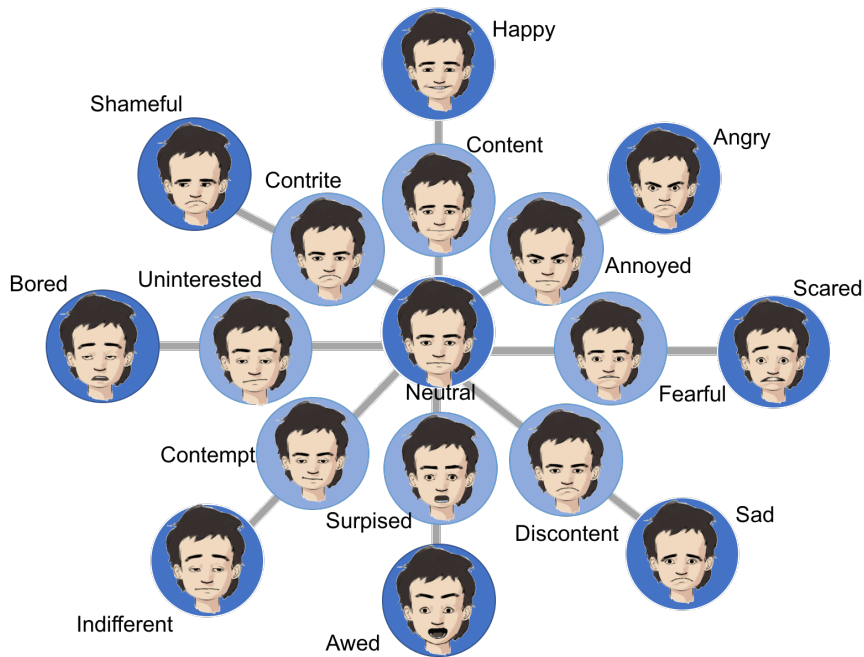

Fig. 5. Emotions Map

5   Methodology and Validation Results

In order to evaluate the emotions map created to support in-game learning, an iterative evaluation process was adopted. The process consisted of two consecutive rounds of evaluation in May 2016, where a set of different facial expressions were tested. The first round was piloted using a digital evaluation method whereby an email was sent to participants, which resulted in a slow response rate. So a paper-based method was adopted for the final evaluation method as it provided a faster response and enabled more control over the quality of participant completion.

The sample of the participants that contributed to the evaluation consisted of two different groups of people: 'experts' and 'non-experts'. The experts consisted of psychologists (recruited from three different UK universities) who were experts in visual expression research, police experts within child interviewing (recruited from one UK police force), and usability experts, (recruited from one UK university). The second

group we termed 'non-experts' refers to participants recruited from the general public (in this case university staff). The justification for recruiting expert participants was to improve the validation of the results gained from the general public (non-experts). A total of 41 participants took part in the evaluation, with a split between non-experts (56%) and experts (44%). Participants' age ranged from 25-55, with a slightly higher female (59%) to male (31%) gender split.   .

The same paper-based survey was employed in both iterations of the evaluation and it consisted of 17 different 2D graphic images depicting different types of emotional expressions. A predefined multiple choice format was used with the addition of an open-ended response, as depicted in the examples shown in **Fig. 6**. Participants were given a paper booklet that consisted of 17 different 2D graphical representations of a facial expression that elicited a particular emotion that could be used within the game. Prior to evaluation, participants were asked to spend a few seconds looking at each face and select from the three choices given, which expression best matched the image. The aim was to illicit participants' initial impression of each expression. They were also given an open-ended response that allowed participants to add any further comments. The results of both rounds were used for the validation, improvement and final choice of the set of facial expressions to be used in the game.

Fig. 6. Facial Expressions Survey

In order to extract the results of the first round of evaluation, the answers of the two different groups of participants were separated. In case of disagreement between the two groups, the experts' choice was favored above the non-experts' choice. However, there was 70% agreement between experts and non-experts, which further validates the results, indicating the innate role of emotion recognition. The result of each round was listed showing the approved, rejected and undefined facial expressions. As approved was considered an expression that either both groups agreed on for more than 50% each, or that only the experts agreed on for more than 50% [41]. Rejected expressions didn't manage to collect the 50% of either group's acceptance and undefined expressions collected only the 50% of non-experts' acceptance. The results of both rounds indicated that –in accordance to relevant literature (see Section 3.1) there is a certain group of facial expressions that are globally recognized by people. Based on the intensity of the

emotional state, we observed that all facial expressions in the outer circle of the emotions map (Level 1) –plus neutral emotional state, in the middle of the map- scored high among all participants and were approved. On the other hand, less intense facial expressions –in the inner circle of the emotions map (Level 2)- weren't that easily identified by all the participants and some of them were marked as undefined of were even rejected.

Analytically, the results of each evaluation round are presented together with the final results of the evaluation procedure in colour-code (green-approved, blue-undefined, red-rejected), as shown in Table 1 below.

Table 1. The Emotions Map Validation Results

N	Level	Emotion	Round 0 - Experts	Round 1 – Non-Experts	Round 2 – Non-Experts	FINAL results
1	1	Neutral	100%	78,2%	100%	Approved
2	1	Happy	100%	91,3%	84,6%	Approved
3	2	Content	60%	34,7%	46,1%	Approved
4	1	Angry	60%	56,5%	53,8%	Approved
5	2	Annoyed	60%	52,1%	53,8%	Approved
6	1	Scared	80%	73,9%	76,9%	Approved
7	2	Fearful	40%	56,5%	69,2%	Undefined
8	1	Sad	60%	56,5%	53,8%	Approved
9	2	Discontent	20%	56,5%	53,8%	Undefined
10	1	Surprised	40%	52,1%	53,8%	Undefined
11	2	Awed	40%	56,5%	38,4%	Rejected
12	1	Indifferent	20%	21,7%	15,3%	Rejected
13	2	Contempt	60%	47,8%	38,4%	Approved
14	1	Bored	60%	60,8%	46,1%	Approved
15	2	Uninterested	80%	60,8%	69,2%	Approved
16	1	Shameful	80%	30,4%	30,7%	Approved
17	2	Contrite	0%	0%	23%	Rejected

In detail, 11 out of the 17 facial expressions were approved by the participants, with the *neutral* expression scoring higher than all the rest. In addition, *happy* and *scared* also scored very high among the participants. The complete list of approved emotions is the following: *neutral, happy, content, angry, annoyed, scared, sad, contempt, bored, uninterested* and *shameful*. The facial expressions that were marked as undefined consisted of 3 emotional states; *fearful, discontent* and *surprised*. Finally, there were 3 emotions rejected by both groups of participants: *awed, indifferent* and *contrite*.

6   Conclusions

This paper reports on the development of the CIS serious game that incorporates triggers for emotional recognition to support the training of rapport building of early career front-line police officers when interviewing children. By using a 2D serious game interface the aim is to increase the focus on some of the key learning skills required for conducting a successful interview. Whilst there is ample literature in emotion

recognition, the results are not easily applicable within the context of a serious game due to the limitations of representing the subtleties of the human face without encountering the uncanny valley [42]. Some of the attempts of crossing the uncanny valley using computer graphics and photorealistic rendering are discussed in [43], which supports the decision for adopting 2D for the recognition of emotions. This paper reports on the process of designing an 'emotions map' for the purpose of developing a child interviewing game-based learning solution. The results of the study support the existing literature in the field of facial emotion recognition, that there are different levels of high and low saliency of emotional recognition. From the 17 facial expressions evaluated, 11 were approved, 3 were marked as undefined and 3 were rejected. Little difference was found between experts and not-experts with a 70% agreement indicating the innate aspect of emotional recognition It should be noted that even though the whole set of facial expressions was tested and evaluated, only a part of them were included in the game. The selection of these expressions will be based on their relevance to the game's episodes.

7   Acknowledgement

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