



## Designing a Training Tool for Transnational Joint Investigation Teams

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Our project aims at developing a virtual tool for training Joint Investigation Teams (JITs) on conducting interrogations of suspects in transnational organized crime. To design an effective training tool that supports collaboration and, at the same time, provides training on collaboration, we propose to combine computer-supported methods for interaction and collaboration with an ITS, extended to train teams. This becomes particularly important when training targets cognition and behaviours of team members that should work together as one.

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# 1 Introduction

## 1.1 The Need for Joint Investigation Teams

Globalisation and open borders came with many benefits from new communication options to easy forms of commerce. At the same time, these benefits created new opportunities for criminal activities creating a steep increase in transnational organised crime [39]. In Europe, for instance, actions have been undertaken to combat these criminal organisations but the transnational context makes investigation, prosecution, and punishment much more complex. Although different cultures, laws and methods create obstacles to cross-border teamwork, international cooperation between law enforcement agents is absolutely required.

In order to tackle transnational crime more efficiently, new European conventions and modern methods of investigation were created. One of these methods is the formation of a Joint Investigation Team (JIT). A JIT is a team of representatives of law enforcement and judicial authorities from several Member States that work together to fight complex cross-border criminality in a close police and judicial cooperation between States [11]. Although it promises to be an effective tool for international cooperation, countries have not widely adopted it [13]. Among other reasons, it is a complex process that requires the development of a myriad of skills that allow law enforcement agents to cope with different cultures, laws and methods, as well as, know how to conduct cross-border teamwork. On the other hand, JITs allow to overcome many bureaucratic aspects of previous tools, which are creating obstacles to cooperation. Hence, training law enforcement agents on this process is key to fight transnational crime.

## 1.2 An Intelligent Tutoring System as a Scaffold for Training

In our project, we aim at creating a tool that supports the training of JITs taking into consideration its related set of challenges: *C1) logistics* (time and space); *C2) need for cohesion*; *C3) communication* methods; *C4) need for a shared cognition* and effective *decision-making*; *C5) coordination* of efforts within the team; and *C6) the team heterogeneity*; The resulting tool will allow geographically distributed team members to train the preparation and execution of a JIT in their home country (reducing time and costs associated) using a mixed-reality environment (C1).

To support the training of skills needed by law enforcement agents to cope with the remaining challenges of a JIT (C2 to C6), we rely on a Intelligent Tutoring System (ITS). An ITS deals with conceptual and procedural knowledge, and at the same time provides adaptive cognitive support to the learner [28]. These adaptive systems have shown [21] to be effective in supporting learning in algebra, law, reading and medicine. Hence it is our stance, that its simple and well-defined structure allows it to be extended (and to be beneficial) to other domains, such as collaborative settings or team training.

Capitalising ideas from ITS to support collaborative and individual learning

is not new in the CSCL<sup>1</sup> community [26, 28]. In fact, some works exploit such approach by either including feedback mechanisms [1] or offering support to the interaction between the learners [17]. Yet, researchers have only investigated the effects of learning by collaboration and how that collaboration can be supported [26]. Little emphasis has been given to actual training of teams and to how Computer Supported Training of Teams (CSTT)<sup>2</sup> can leverage from a structure of an ITS. A recent work by Sottolare and colleagues [36] underlines that some of the challenges of team training are common to ITS community, although with a different focus. To cite one example, the system needs to keep track of individual learner and team goals and provide instructional strategies and interventions for the team as a whole and for each individual member [36]. Following this argument, in this paper, we propose that an ITS is a viable option to support team training in a collaborative work environment, mainly in domains where the presence of a human tutor is either undesirable or unavailable. To illustrate our case we present a model for the training of JITs, on the interrogation of suspects and its preparation.

## 2 Understanding Cross-National Investigation

### 2.1 Understanding JITs

A Joint Investigation Team (JIT) is a team of representatives of law enforcement and judicial authorities<sup>3</sup>, who investigate complex cases of transnational crime [2]. The JIT is composed by as many law enforcement agents as necessary, as long as a formal proposal is made and it makes sense for the criminal investigation. Any JIT has a team leader that is the representative authority of the ‘host’ Member State, that is, the country where the investigation is based on. The other members of the team must act within the limits of their competence under national law and the operations shall be carried out in accordance with the law of the Member State in which they are operating.

Belonging to a JIT allows Member States to take investigative measures on request from other Member States considering it a national investigation measure. Additionally, to facilitate the work of the JIT, Member States can provide the team with information available in their Member State for the purpose of the criminal investigations.

It is clear that being in a JIT requires that one has a basic knowledge of the legal traditions in a country. The legal systems of cooperating countries will be confronted with their differences, which can hamper the effectiveness of joining forces transnationally [34]. Furthermore, members of the team must find a common ground and establish areas of mutual benefit for fruitful collaboration [29]. This implies to have mechanisms to develop trust relationships and that promote effective communication.

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<sup>1</sup>Computer Supported Collaborative Learning.

<sup>2</sup>In the literature we can also found the term Computer-Based Training of Teams

<sup>3</sup>Those are from several Member States, and sometimes from other organisations such as Europol and Eurojust

## 2.2 Framework for Joint Interrogations

In practice, a critical element of the coordinated actions of a JIT is when they have to perform a joint interrogation, to gather information for the general investigation. In general, a police interrogation has different goals depending on the type of legal system in which the pre-trial investigation is embedded. In this project, we adopted the *PEACE Method* which is focused on information gathering methods of interrogation (as opposition to confession oriented interrogation). The PEACE method consists in:

**P** *reparation and planning* refers to a phase during which team members prepare timings and content of the interview. It is important that they know the procedure (that complies with the laws in the different countries), know the case (people of interest, locations, evidence) and know the suspects (personal information and professional relations). This step involves individual and group preparation.

**E** *ngage and explain* is related to the way the interrogation is conducted. Interrogators should try to develop empathy with the suspect and follow a specific set of actions.

**A** *ccount, clarification and challenge* is related to the way questions are posed to the suspect being interrogated. The goal is to seek information and clarification on the crime(s) and the suspect's role in it.

**C** *losure* refers to summarising what have been discussed and inform the suspect about the next steps.

**E** *valuation* occurs when the interrogator returns to the team to discuss what information has been acquired and how this information relates to the case. The team then decides what further action should be taken.

## 2.3 Challenges in Cross-National Investigation

Training multinational teams is a challenge by itself since it is time consuming, expensive and complex to organise. Literature focusing on cross-national Joint Investigation Teams [2, 11, 13, 29, 34] refer to challenges that may hinder the formation and effectiveness of such teams. In this section, we outline the main challenges in training cross-national investigation teams.

### 2.3.1 C1 - Logistics

Managing geographically distributed teams can be a challenging and cumbersome experience. The logistics include setting up the time and location and dealing with travel arrangements, resulting in expensive and time consuming events [13].

### 2.3.2 C2 - Cohesion

Cohesion is a key variable to effective teamwork processes [4] as it is related to attraction and desire to remain in the team, as well as a commitment to the task

[18]. Team training may foster the development of team cohesion, but it is important that in the process team members become aware of the advantages of effective communication.

### 2.3.3 C3 - Communication

Effective communication in cross-national investigation is a cornerstone of success of coordinated actions towards a shared goal. Although JITs were created, among other reasons, as an instrument to facilitate the exchange of information across borders without formal requests [13], there are still many aspects that can hamper effective communication. Those are common to global virtual teams, as described by Lacerenza et. al [18]. For instance, the communication method may impact the richness and quality of information exchanged or people are not available at the same time (asynchronous discussions). Other issues include trust among members and with that type of information that it is shared with other team members (as referred below in C4). An ineffective communication and lack of cohesion can lead to the existence of nullifies<sup>4</sup> in the criminal process.

### 2.3.4 C4 - Shared Cognition and Decision-Making

*Shared Cognition* refers to the team's ability to have a shared understanding of their roles, tasks and situations [18, 32]. Having a shared mental model is a critical element for a team to plan strategically and make compatible decisions [24]. Oppositely, its absence may result in opinions based in different viewpoints, which can result in poorer decisions [41]. Preparing for an interrogation (first step of the PEACE methodology) requires that the team members share and integrate information, coordinating and cooperating in the team decision-making process [33]. This can be a challenge in the context of JITs for two main reasons: police forces may have additional individual goals; and the JIT members may hold different information about the case.

### 2.3.5 C5 - Coordination (Leadership)

In joint transnational teams the coordination of the people involved is fundamental. Two key aspects that characterise *explicit coordination* are planning and communication [30]. Planning includes setting goals, creating an open environment, finding time for sharing information and clarifying the roles and responsibilities. In previous research [38], researchers found that finding time to plan is a clear factor towards an effective team when coordinated decision-making is required. Although the ability to communicate effectively can be seen as a team skill, the team leader has an additional role to coordinate the discussion. Team leaders should ensure that everyone is engaged and heard during the meeting [22].

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<sup>4</sup>Evidence that is not admissible in criminal court. This may vary among law systems.

### 2.3.6 C6 - Heterogeneity

The heterogeneity of transnational teams is likely to create language and cultural barriers. In the context of joint interrogations, different countries may follow different methodologies both in the investigation and interrogation of suspects. Moreover, countries may have different legal requirements that need to be fulfilled in order to use a particular interrogation or to be able to get a conviction. These differences may hamper the effectiveness of transnational JITs [34]. The ability to cope with cultural differences and a good knowledge about the legal system of the cooperating partners are two crucial elements for successful JITs [2].

## 3 The Design of a Training Tool for JITs

Joint Investigation Teams (JITs) may engage in joint or parallel investigations, but in this project we focus solely on the interrogation of suspects and its preparation. As a scaffold for the training we follow the PEACE methodology, which sets out the steps of a training session. In this section, we describe these steps, which constitute a training trajectory. Following that we outline the training goals in the context of our project and we discuss how they relate to the main challenges in JITs. Moreover, we describe our *Training Tool*, which relies on the classic architecture of an Intelligent Tutoring System (ITS) in order to support the monitoring, evaluation and tutoring of the trainees.

### 3.1 Training Trajectory

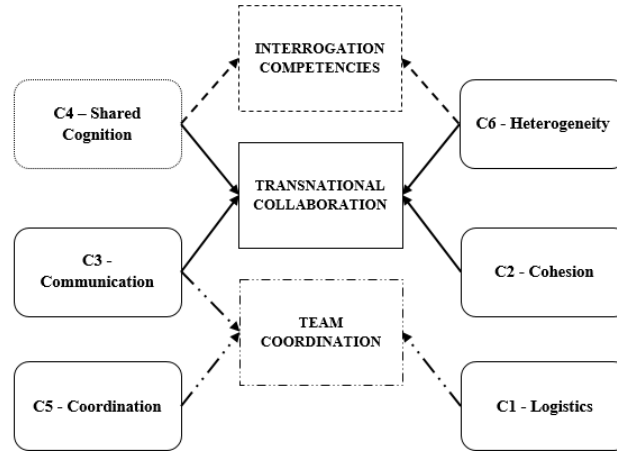
A single training session is divided in four main phases: *Individual Preparation*, *Joint Preparation*, *Joint Interrogation* and *Debriefing*. In the **Individual Preparation**, each trainee is assigned a casefile with several records. Each record may be known by all, some or just one member of the JIT<sup>5</sup>. In this phase, trainees have time to explore and study the casefile by themselves. They are able to access records, take notes and gather important records for the following phases. During the **Joint Preparation**, trainees are able to discuss the case, share files and prepare the interrogation (e.g. legal procedure and strategy). In the **Joint Interrogation**, one or two trainees interrogate a *Virtual Suspect*, while the others may observe the interrogation in a control room (still able to discuss and share files with the others). The final phase is the **Debriefing**, where trainees receive detailed feedback about both their own performance and overall performance of the JIT.

### 3.2 Training Goals

Cross-national investigations, and in particular the interrogation of suspects, present multiple challenges (outlined in a previous section) that should be addressed during training to guarantee a fluent cooperation in real scenarios. Based on the challenges faced by JITs, in our project, we aim at providing training in: (1) Training team

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<sup>5</sup>This simulates a situation where information is distributed. Each member holds unique information that may be critical for their tasks.

**Figure 1:** The specific challenges of each training goal

coordination skills; (2) training interrogation competencies; (3) training transnational collaboration and collaborative decision-making. These competencies are to be acquired throughout the whole training trajectory itself. In Figure 3.2, we detail the challenges associated to each training goal.

### 3.2.1 Team Coordination Skills

This training goal is directly linked with the *Coordination* challenge (C5), which refers to one's ability to lead the investigation by planning in advance and coordinating the communication among trainees. Concerning planning, which is also related to *Logistics* (C1), the team leader should pre-define the agenda for the *Joint Preparation* and guarantee it is followed by the JIT. During the *Joint Preparation*, the team leader should coordinate the discussion and define the strategy for the *Joint Interrogation*.

### 3.2.2 Interrogation Competencies

*Interrogation Competencies* are strongly connected to the PEACE methodology, which has received the most attention in research about information gathering methods of interrogation (e.g. [14]). The *Heterogeneity* (C6) of a JIT demands that trainees are trained to follow a methodology that is well grounded on theory in order to be accepted by all police forces involved. Good interrogation competencies, which include *Planning* and the actual interrogation, not only enhance the ability to gather information about the criminal organisation and its activities, but are also a step towards the avoidance of nullities in countries that may have a slightly different legislation.

### 3.2.3 Transnational Collaboration and Collaborative Decision-Making

This training goal tries to address several challenges in cross-national JITs. *Strategy Planning* (C4) and team's *Heterogeneity* (C6) are likely to be a challenge when



defining legal, formal (e.g. who interrogates, breaks,..) and content strategy for the interrogation. Moreover, team *Cohesion* (C2) and trust are of paramount importance to guarantee that the team is committed to reach the goals of the JIT. Therefore, it is important to keep track of trainee's effort preparing the case, their sharing behaviors and commitment to team decisions. Good team *Cohesion* (C2) and *Communication* (C3) skills, which may be measured for instance through participation times, interruptions or overlapping speech, are key to guarantee team *Shared Cognition* (C4). This last challenge has greater impact on the quality and compatibility [24] of the decisions.

### 3.3 Modelling Training with an ITS

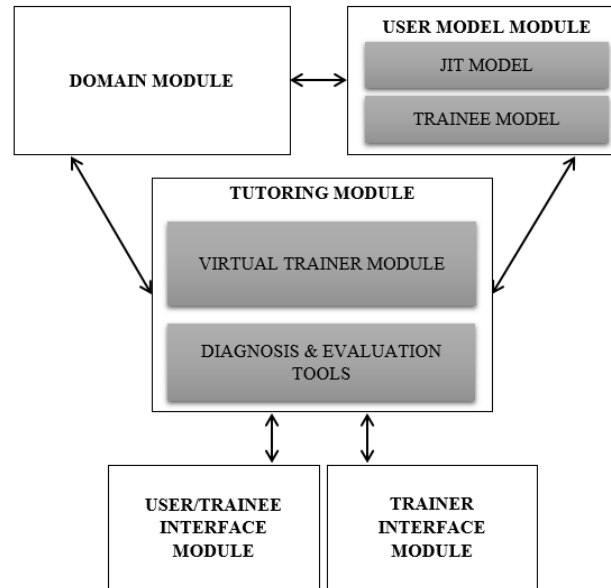
An ITS is a computer systems with intelligence aimed at providing tutoring and training on a specific topic usually without the intervention of a tutor [9]. These systems use techniques that allow them to continuously assess students' knowledge in order to be able to adapt to their needs. Intelligent tutors are dynamic systems that build a cognitive model of the student and thus are able to produce more sophisticated challenges as the learner's knowledge increases [43]. A classical architecture of an ITS is characterised by 4 basic components: the *Domain Model* (expert knowledge), the *Student Model*, the *Tutoring Model* and the *User Interface* [26], which can take different forms from simulations, to collaborative systems or serious games. We propose that the classical architecture of an ITS can be adapted to the training of a team (and to the training of JITs in particular), as long as researchers find a comprehensive way of representing the *Domain*<sup>6</sup> and make a clear separation of the *Trainee* and the *Team Models*. Our proposed architecture is depicted Figure 3.3. Herein, we describe the main modules of our *Training Tool* and which type of information each of them contain.

#### 3.3.1 Domain Module

The *Domain Module* refers to the rules, concepts and strategies that are part of the domain to be learned and include standards that allow assessing the trainee's performance [26]. This module contains all the knowledge necessary to feed both the *User Model* and the *Tutoring Module*. In our project, trainees need to coordinate actions in a joint investigation of a drug trafficking crime that culminates in a joint interrogation of a *Virtual Suspect* (see *Training Trajectory*). For that reason, the central piece of this learning system is a *Virtual Case*. The *Virtual Case* contains the description of the criminal organisations involved in the crime and their main characters and operations. Moreover, it contains a representation of all events involving the criminal organisations and interactions between characters, which we call the criminal *Story*. To deal with such complex domain, the story is a semantic network of events that resemble the structure of autobiographical memory [6], similarly to what Campos and Paiva [3] did to support a conversational agent with abilities to store and use memories. One of the reasons for such approach is because it allow us

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<sup>6</sup>In the case of our project we needed to find a clean representation of the domain that is useful for training and easy to use by the tutoring component.

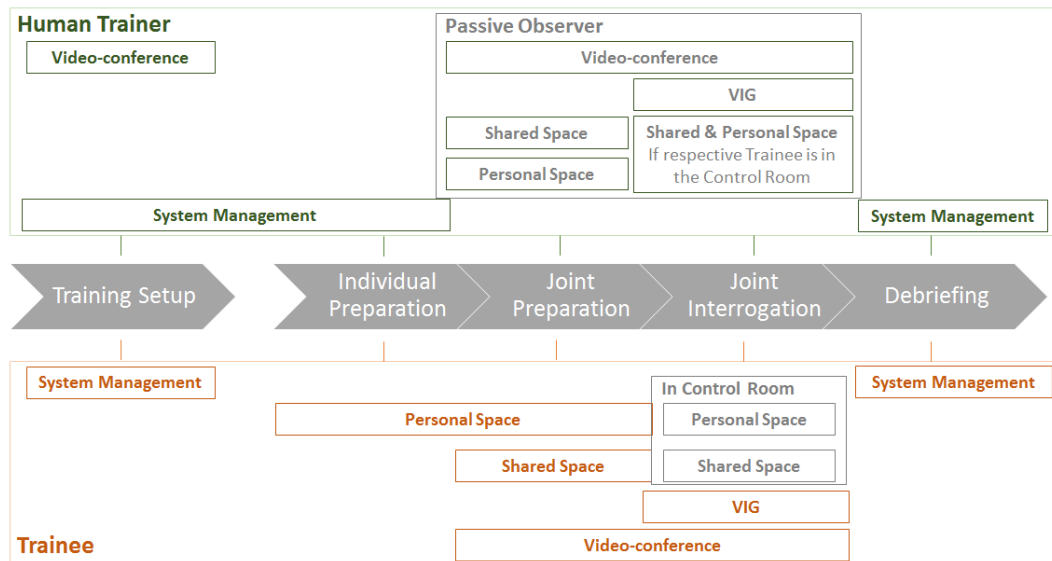
**Figure 2:** Our architecture derived from the classic ITS architecture

to have a simple representation of an intricate network of events. Another reason is to enable us to verify how the trainee explores the story when interacting with the *Virtual Suspect*. Successful interrogators need to understand how memory works in order to ask the appropriate questions to reconstruct the suspect's story [23].

Additionally, *Domain Module* contains information about how the casefile and its records are distributed among trainees, possible questions and answers for the interrogation with the *Virtual Suspect* and the best practices and methodology for conducting joint investigations and interrogations. For instance, questions are tagged (e.g. open-ended or closed questions; suggestive questions) in order to enable the evaluation of the trainee's interrogation competencies according to the PEACE methodology.

### 3.3.2 User Model

The *User Model* represents the actions and knowledge of the team and of the individual trainee. It is essentially a dynamic module that must keep track of the trainee's cognitive and affective stages throughout the learning process [26]. In the end, it is expected to outline the trainees' competencies and achievements [42]. The importance of this building block lies on the fact that it holds all the information required by the *Tutoring Module* to provide adequate feedback, performance diagnosis and propose new challenges. It gathers the information of all actions and decisions of each user (*Trainee Model*) and of the whole team (*JIT Model*), throughout the interaction(s) with the system. It includes, for example, the user profile based on preliminary questionnaires; the files that were accessed by each trainee; the files shared; and the knowledge of the story events in the perspective of both the Trainee and the JIT.



**Figure 3:** The active interface areas during the training session phases for the *Human Trainer* and *Trainee*.

### 3.3.3 Tutoring Module

The *Tutoring Module* is the central component of the *Training Tool* since it manages the *Diagnosis and Evaluation Tools* and the *Virtual Trainer*. The module is responsible for deciding what actions to take and when, based on the domain and student models. These actions will then be presented to the student through the interface, taking the form of hints or dialog. In complex domains, the ITS requires that the *Human Trainer* assists the tutoring by providing feedback in different points of the training. In the case of this project, the *Human Trainer* may only intervene after the training session, therefore all the interventions will be done through the *Virtual Trainer*.

The *Diagnosis and Evaluation Tools* are transversal to all the training session phases and intend to monitor the JIT interactions and decisions during the preparation and interrogation. These tools use data from user interactions, combined with the theory on best practices and methodology for preparing and conducting joint interrogations. The *Virtual Trainer* relies on the *Diagnosis and Evaluation Tools* to have a full understanding of the users' actions and decisions. The constant monitoring done by these tools enables the representation of the *User Model* (both the *Trainee* and *JIT* models). By combining this knowledge with the *Domain Module* (which represents a *god-view* of the system), the *Virtual Trainer* is responsible for deciding what actions to take, when to intervene and how to present the performance evaluation to the trainees and to the JIT.

### 3.3.4 User Interface

The users of the system can be divided in two groups: *Trainees* and *Trainers*. These users interact with the system in distinct ways. Trainers have an active role

when setting up the system and a passive role when observing the training session. Trainees have an active role throughout the training session. In order to enable users to prepare the case individually, discuss and collaborate with their peers and practice joint interrogations with a *virtual suspect*, the *Training Tool* relies on five main components (Figure 3)

- **Personal Space.** It is the area where a trainee prepares the interrogation by himself and is available during the Individual and Joint Preparations and in the Control Room, but can only be accessed and viewed by the respective Trainee. Trainees are able to explore their casefile (browse and search), open specific records, take notes and add records to their personal libraries. Additionally, the team leader may prepare the agenda for the *Joint Preparation*.
- **Shared Space.** The shared space can be defined as a shared display where the JIT prepares the interrogation as a team. This area is available during the Joint Preparation and in the Control Room, and can be viewed by all members of the JIT. Besides having a chat interface, this area has a white-board/bulletin-board interface where trainees may share or display their records with the team. Moreover, it shows the pre-defined decisions that the team need to discuss and input in the system (e.g. who interrogates the suspect, presence of lawyer or prosecutor, topics to be addressed during the interrogation, evidence to be disclosed during the interrogation, ...).
- **Video-Conference Tool.** The video-conference tool enables the communication between *Human Trainers* in the *Training Setup* phase and between *Trainees* in the *Joint Preparation* and *Joint Interrogation* phases. Moreover, it allows *Human Trainers* to observe and listen to these phases in a passive mode (not able to intervene).
- **Virtual Interrogation Game (VIG).** It allows trainees to take part in a Question-Answer session with a *Virtual Suspect*. This particular component is at the core of the whole system as every other component is designed with the actual interrogation in mind. It consists in a turn-based game: trainees make a statement/question and the suspect answers. The *Control Room* enables to visualise everything happening in the virtual game.
- **System Management.** It refers to the user's profile and training session management (e.g. training setup, check performance and assess progress).

## 4 The Role of the Trainer

In our system, we identify two main actions for the trainer's role: training and evaluating. In other words, a trainer has to prepare a session allowing both the training of an agent on how to conduct a Joint Interrogation and the evaluation of the agent's performance during that session. In the particular context of training Joint Interrogation Teams of police officers, it is important to take into consideration the diplomatic aspect underlying the task. Since each country might have different

techniques and methods for training agents (including different training goals) and for conducting interrogations, it is important that the system let the trainers of each country focus on their own trainees and on the joint goal of the interrogation. A trainer should not be able to give an evaluation of a trainee from another country. Therefore, a trainer is only able to access the individual data corresponding to his trainees only. Whereas he is able to access also data about the JIT performance, therefore the group, this information alone should not let him make an assessment on the individual performance of the others.

Additionally, once a session has started, the trainees should be interacting with each other only and the trainer can not intervene any more. By preventing the intervention of trainers during a session, we incite trainees to collaborate with each other as they can't rely on their trainer. More importantly, it prevents the trainers to influence the training of agents not from their own country. However, assistance and help might still be required by the trainees at some point during a session, in order to prevent some critical mistakes or to propose some advices during the interrogation if they don't seem to perform well.

Therefore, we propose to use a Virtual Trainer, an autonomous intelligent entity capable of providing that assistance to the trainees in a very discrete and neutral fashion. The Virtual Trainer uses its knowledge of each data generated by the trainees' activities to perform critical interventions, and to provide precise and detailed feedbacks at the end of a session. Depending on the level of intervention desired by the Trainer, the Virtual Trainer can vary its behavior between never intervening and intervening frequently. In a sense, the Virtual Trainer works as an assistant for the Trainer by keeping track of all the data for the trainer and by providing feedback on it. Then it is the role of the Trainer to use this data to evaluate the performance of the trainee.

In order to build the Virtual Trainer, we are dividing its actions into three layers. The explanation layer allow the users (trainees and trainers) to ask directly for clarification on elements displayed within the interface. This is used for instance to provide a more detailed explanation about a particular measure made during a session (like the number of relevant questions asked) and that is presented during the debriefing phase. The critical error layer allow the Virtual Trainer to intervene immediately before a critical error is made and nullify the whole session. For instance, it is important that the trainees ensure that the configuration and planning they make during the joint preparation are made according to the desired Legal Procedure. The Training Trajectory layer is the one producing interventions depending on the level of assistance desired. Its task is to assess the performance of the trainee using the data generated by the session in order to autonomously decide if an intervention (Which could be for instance a feedback, a summary or an advice on future course of actions) is required to help the trainee.

The Virtual Trainer's interventions should take into account the police methodology that underlies the whole training but also needs to consider the ethical aspect of the learning process. This last concern brings forward several challenges when the evaluating the trainee's performance, mainly regarding the second and third layer of the VT's actions. The critical error layer should warn the user in a discrete way, such that he is able to identify his mistake and learn an adequate action without

judging him in the process. The debriefing phase of the session, that holds a lot of third layer type of actions, must evaluate the training session without showing a score or comparing his performance with the remaining elements of the JIT. So, to comply with the user's ethical requirements, the Virtual Trainer should present feedback in a way that only emphasizes the areas of interest in the debriefing interface. According to the elements highlighted, the intervention should promote the review and analysis of the trainee's actions identified, show a detailed explanation of the methodology section related to these actions and, if needed, recommend to discuss with the Human Trainer specific sections of the training session.

To summarize, we propose to give to the trainer a virtual assistant in order to complete its roles. The trainer has the role of preparing the training session, observing the session and using the data collected by the Virtual Trainer to perform an evaluation on his trainees' performance. The virtual trainer has the role of intervening during a session if required and monitoring and presenting the data to the users along with some explanations.

## 5 Tutoring Supported by Collaborative Tools

Tools to support CSCW aim at facilitating group activities through the usage of computer software. These tools include, for instance, synchronised calendars, shared workspaces, task managers or communication systems (e.g. video-conference or chat). By themselves, they address some of the aforementioned challenges. For instance, *Logistics* (C1) may be simplified with the use of video-conference (avoiding location and travel issues) and schedule (such as doodle pools) tools. Moreover, *Shared Cognition* (C4) may be improved with the use of Group Support Systems or shared displays (e.g. [5]). These interfaces promote information sharing, which eases the creation of shared mental models.

Although CSCW tools may provide support that mitigate these challenges, in training tools (intended to provide adaptive feedback) it is mandatory to relate how the users' actions impact and may be measured according to the training goals. By integrating an ITS, actions through the interface have an associated semantic value which enables an automatic performance assessment. Moreover, the presence of a 'third entity' - the tutor - enables in-time interventions and feedback adapted to the learner needs.

In this section we outline a proposal of what our tutor, the Virtual Trainer, could monitor throughout the training trajectory and how it could interpret that information to build the trainee and the team model. The monitoring of specific pieces of the interaction tries to meet the training goals and find a systematic way to assess the trainee and team's performance taking into account the limitations of the technology.

### 5.1 Modeling the Trainee and the Team

The collaborative training tool tries to address the challenges of cross-national investigation; however, it is the interaction between the actions taken on the virtual environment and the ITS-based architecture that enable modeling the trainee and

team behavior. This ability is key to assess trainee and team performance, as well as to provide detailed and timely feedback. Herein, we outline the measures gathered by the ITS and how they allow us to train, model and evaluate how the JIT copes with the main challenges of cross-national investigation.

### 5.1.1 Team Coordination Skills

The main challenges of effective *Coordination* are planning and communication. Concerning planning, the team leader needs to **prepare an agenda** for the joint preparation and lead its discussion in order to define the team strategy. The team leader should develop plans with **reasonable timings, prioritize tasks and co-ordinate the sequencing of activities**. Moreover, s/he should be able to **co-ordinate the pacing and the speed of task accomplishment**, as well as the **compliance with the plan** [44].

Moreover, the Lead Trainee should make sure that all Trainees are engaged in the discussion (measured through *participation times*) and try to guarantee a **correlation between participants' speaking times and the amount of information they share**, since an asymmetry between these two variables can be an indicator of poor performance [37].

### 5.1.2 Interrogation Competencies

The guidelines of the PEACE methodology are key to assess how trainees perform during preparation and interrogation. Herein, we outline how elements of the interface enable an evaluation of a good understanding of the methodology.

In the first phase of the PEACE methodology, *Preparation and Planning*, Trainees need to acquire as much knowledge as possible about the case. In order to be able to know the case, Trainees should take their time to explore the case file. Although by itself this measure does not assess the *Trainees'* knowledge about the case, the time spent in the Individual Preparation shows the **effort put in the preparation**, which may reflect team *Cohesion*. A more effective way to measure the effort is to monitor the records that were accessed, commented and marked by the Trainee, within each training phase. Another means to measure *Cohesion* is to compare the decisions made by the team in the *Joint Preparation* against the actions taken by each *Trainee* during the interrogation in terms of legal procedure and the interrogation strategy.

However, the effort by itself does not guarantee a good preparation. It is important to measure the **ratio of relevant and irrelevant records** that trainees acted on. Another way to understand the amount of information acquired, is to monitor the amount of information (from the story) that was discovered by the Trainees. While this is an important measure to assess each trainee's individual preparation, by monitoring the records shared and known by the whole team we may assess their shared mental model of the criminal story. This assessment can be updated during the interrogation, based on the answers of the *Virtual Suspect*.

The JIT also needs to decide on the topics they will address during the interrogation and the strategy for evidence exposure. This *Decision-Making* process enables the *Virtual Trainer* to analyze how much information from the whole story

is covered by the JIT strategy. Moreover, during the interrogation it is important to assess if the interrogator follows the team plan (comparing topics planned and actually addressed). This also includes the strategy for evidence exposure and its use during the interrogation (early, gradual or late exposure; as well as what records are exposed).

During the interrogation, there are pre-determined steps that trainees should follow in each (PEACE) phase. For instance, during *Engage and Explain* trainees should present themselves, explain why the suspect is being interrogated and her/his rights, among others. Moreover, during the *Account* phase, trainees should perform more open-ended questions to encourage free account, instead of closed questions. The ability to tag trainees' statements enable modeling users' accordance to the PEACE methodology. Moreover, the story representation based on autobiographical memory (focused on events like [3] did) enables analyzing if trainees are able to ask follow-up question, timely, when specific information (the *who*, *what*, *where*, *when* or *how*) about a particular event is missing.

Alongside with these steps that should be followed, there are actions that may compromise the validity of the interrogation and jeopardize the whole case. The need to train the avoidance of nullities is augmented due to the *Heterogeneity* and legal differences among the countries represented in the JIT.

### 5.1.3 Transnational Collaboration and Collaborative Decision-Making

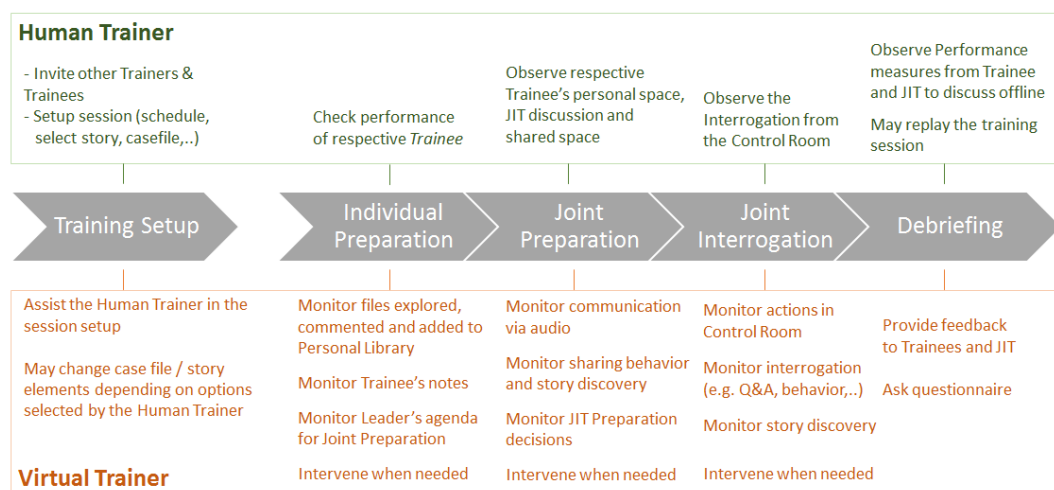
*Transnational Collaboration and Collaborative Decision-Making* requires that *Trainees* work as a whole, in order for the team to achieve its goal. In order to assess collaboration among the trainees, **the amount of information shared** by each of them is crucial to ensure the *Shared Cognition* of the team. In particular, it is important to measure the sharing behavior concerning records that are only available to a particular trainee's country, which may also be a good indicator of team *Cohesion*.

The **amount and quality of communication** within a team is at the heart of the norms for effective collaboration. One way to gather that kind of data is to pay attention to the speech channel. Recent research has shown that several non-verbal vocal cues, such as laughter, fillers, back-channel, silence and overlapping can carry and convey social meaning [40]. For instance, back-channel, which (in English) correspond to expression such as 'yeah', 'aha-aha' and 'hum' signal, in most cases, attention and agreement. On the other hand, overlapping speech is associated with dominance and higher-status [40]. Oertel and colleagues [27] distinguish competitive from collaborative overlap, where the first refers to one speaker's competition for the right to speak (e.g. to change the topic or state his opinion), while the latter refers to assisting the current speaker (and may include back-channel). Grezes and colleagues [10] found that the ratio of overlapping speech to non-overlapping speech in a debate, alone, could predict the conflict class (low/high) with good accuracy. In fact, predicted overlap is more reliable than other acoustic-prosodic features. Therefore, features characterising the dialogue structure, such as turn duration, interruptions and silences may be good descriptors of team communication. Kim and colleagues [15], used a set of conversational features such as **duration of turns**, **individual speaking time**, **amount of overlap** and **turn-taking pattern** to study how



to automatically detect escalation and de-escalation of conflict. They found that these features yield success in identifying conflict situations in televised political debates. In addition, the knowledge about their interaction (the speaking times of each participant), may influence the group behaviour when there is over or under participation by some members [7]. For the evaluation of the speech communication among Trainees, it is essential to have access to each individual speech channel to assess features such as speaking times, overlapping speech and the patterns of turn-taking.

However, a greater challenge is to monitor and measure collaboration and the decision-making process in real time in order to provide adequate feedback if needed. The aforementioned communication features are a good example, but other measures are needed in order to make an effective assessment. For instance simple measures include, we may measure and try to understand how the **time spent on each task** influences an effective collaboration and decision-making. Furthermore, the user interface should allow users to **show their disagreement about decisions** made by the team. By having an ITS we can take advantage of technique of Artificial Intelligence and test mechanism based on the features of the interaction that can point us valid models of good collaboration, for instance.



**Figure 4:** The roles of the *Human* and *Virtual Trainer* in each phase of the training session

## 5.2 Tutoring: Virtual Trainer and Feedback

Besides monitoring, two central elements in the *Tutoring Module* are the tutor (*the trainer*) and how to intervene and provide feedback. A classical approach in ITS, when dealing with ill-defined domains, as is the one addressed in this project, is to include the tutor/human trainer in the loop and allow him to have an active role. Yet, herein human trainers have a passive role and can only provide **offline** feedback to their respective trainees, based on two main reasons: First, it is not suitable for a human trainer from one country to give feedback on the performance of trainees from

other countries (this would be common to any type of team). Secondly, we would like to give trainees the opportunity to train with their peers and get thorough feedback, without always needing a third party (i.e., a human trainer) to be present.

Therefore, this tool has two types of trainer: *Human* and *Virtual Trainer* (Figure 4). The Virtual Trainer has a more active role, as it monitors the training session and provides feedback to the team and each trainee. Feedback is a very powerful tool that can influence learning in a negative or positive way. Based on several studies, Hattie and Timperley [12] centered their model of feedback in three main questions: "Where am I going?" corresponds to the learning goals; "How am I going?" relates to the progress made to achieve those goals; and "Where to next?" refers to the activities that need to be performed to reach the learning goals. The authors claim that feedback should be centered on the attainment of the training goals [12], which should be clear, well defined [16] and specific, rather than general, in order to provide directed feedback and clearer success criteria [20].

There are contrasting results regarding the greater effectiveness of immediate or post feedback [12]. For instance, Lamb et al [19] show the importance of providing ongoing feedback when training for investigative interrogation purposes. However, in order to avoid over-interrupting the training sessions in this collaborative context, most feedback often needs to be presented after the interrogation is completed. The *Virtual Trainer* follows a coaching approach, by being aware of the individual learning goals, in order to expand the trainees' personal competencies and expertise [35]. Although most feedback can only be presented after the interrogation is completed (e.g. learning goals), the *Virtual Trainer* may intervene in situations where immediate feedback is more beneficial. This occurs in situations where providing feedback immediately, rather than presenting post-feedback general metrics, helps users better understanding their mistakes. However, such interventions should be minimized.

In order to support both immediate- and post-feedback, the *Virtual Trainer* is a multi-layer intelligent system, each layer independent and representing different types of feedback (deactivated when needed). Heavily based on previous research [8], the *Virtual Trainer* has three layers:

- Critical Error Layer (Reactive layer in [8]). Triggers immediate interventions when critical errors are made by the Trainee.
- Explanation Layer (Controlled). Provides more detailed information about the descriptive feedback given to trainees.
- Training Trajectory Layer (Cognitive). May propose actions to the Trainee depending on the current state of the training session and on his current performance.

Although these layers provide some indications on the feedback presented to trainees, it is still a challenge to determine how and what feedback should be presented to users, minimizing interruptions and increasing the effectiveness of interruptions and post-training feedback. However, it is clear that users need to have a clear understanding of the criteria used to assess their performance so that they can

establish a relation between their current knowledge and their goals [12]. Moreover, it should be clear what feedback concerns the Trainee and what concerns the team [25].

## 6 Discussing the Training of Distributed Teams

The need to support geographically distributed teams boosted the research and development of computer systems that allow for effective collaboration. CSCW tools enable teams to schedule, communicate, work simultaneously or share views and work spaces. While these tools are key to collaborative work, training requires a deeper understanding of the actions taken by the users. Our approach to use an ITS intends to create a synergy between these two domains. The ability of CSCW to cope with the challenges of cross-national collaboration in general, and of JITs in particular, needs to be leveraged by creating standards for measuring learners' abilities using the technology available.

In this paper, we gathered a set of training goals derived from challenges that are inherent to cross-national collaboration, applied to the particular case of JITs. We argue that a clear relation between interface elements and how they affect the training goals and user performance enables an automatic and interactive tutoring experience. Our approach relies on an ITS architecture capable of integrating a comprehensive domain knowledge, with interaction modes directly linked to training goals and performance measures built to model the user (and the team). This connection enables modeling users' performance, but a major goal of an ITS is also on how to provide feedback in a way that users gain competencies in the training goals defined.

A major challenge in collaborative contexts is when and how to intervene. Besides the advantages of ongoing feedback when training interrogations [19], concerns about over-interrupting the training sessions demand a careful study of intervention mechanisms and content. Moreover, while measures for effective collaboration exist (e.g. [31]), the ability to provide (timely) feedback depends on technology's ability to gather and analyze data in real time. For instance, while we may capture communication patterns such as trainees' participation times, overlapping speech and turn-taking behavior during collaborative decision-making, it is more challenging to keep track of the discussion topic.

Furthermore, feedback needs to be oriented to the training goals and current user performance [12]. However, research on areas such as information visualisation may be explored to convey the desired information to trainees. This may be of greater importance in scenarios where trainees do not want to be evaluated, whereas visualizations may be used to influence users' behavior without a clearly stated evaluation.

## 7 Conclusions

Cross-national crime requires that law-enforcement crosses borders as well. During the life of our project we intend to develop a system that will offer trainees

an environment to train interrogation, coordination and communication skills by considering the entire training trajectory of a Joint Investigation Team (JIT). The interactive system offers a collaborative environment to the trainees, where they can decide on the best ways to coordinate their actions. Yet, as pointed out by other researchers “offering tools for collaboration does not imply that collaboration will occur”. Modes of achieving good teamwork and team effectiveness need to be fostered and trained. For that reason, we propose to combine an Intelligent Tutoring System (ITS) with CSCW tools, to support the training of a JIT (or other type of team, in general).

By combining an intelligent tutor with a collaborative environment we create new opportunities for measuring training without relying on self-assessment questionnaires, for instance. Nevertheless, additional research is required to understand how to provide valuable feedback and to understand what type of interventions fit this type of application. Furthermore, more research should be devoted not only to how to take advantage of CSCW tools to the analysis of interactions and decision-making, but also to how we can build richer user models by using Artificial Intelligence techniques.

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