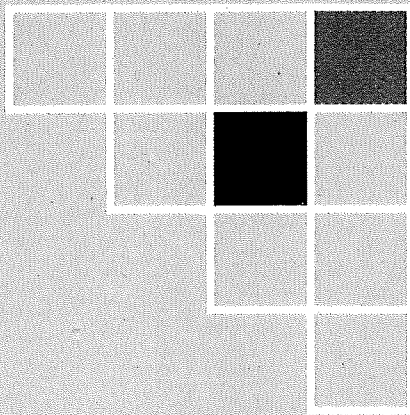


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# KEY COGNITIVE APTITUDES IN PREHOSPITAL INTERVENTIONS

## What we learned from activity analysis of ambulance crews.

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## 1. INTRODUCTION

As it is for many high demanding jobs, selecting and developing the skills of future ambulance personnel follows a rigorous procedure. Ambulance professionals face important work related physical, cognitive, and emotional demands. Compared to other health professions, ambulance personnel are characterized by a high rate of early retirement for health reasons [1;2]. This could be the consequence of particularly strenuous working conditions. This profession is characterized by a high rate of occupational accidents [3-5], a relatively high prevalence of musculo-skeletal disorders -chiefly back problems [6], as well as a high prevalence of mental health problems including depression, alcoholism, and post-traumatic stress disorders [7-9]. Such health outcomes are the consequences of many factors consisting of dangerous and unpredictable work environment, frequent and close contact with suffering individuals, time constraints in carrying out critical actions, an important responsibility in life threatening situations, awkward postures and heavy load handling in non optimal environments, night shifts, unpredictable work activity, etc.

To face such demands, ambulance people must be well trained and have the required skills and aptitudes. The aim of the present study was to identify and document some key aptitudes used by ambulance people in real interventions. Better knowing such aptitudes was necessary for a school of ambulance people in order

to improve the selection and education of students. The idea was to better consider real work requirements and characteristics in order to develop educational content and selection tools.

The focus of our study was on cognitive and cooperative aptitudes. A future study will address physical requirements in a specific way.

## 2. METHOD

We followed and filmed the work activity of ambulance personnel involved in real emergency situations. We followed two teams of two ambulance male personnel during two work shifts (total 24-h), from the beginning of the work shift to the relief by the next team. The seriousness of situations we observed ranged between a minor cut to the forearm and a life-threatening problem that necessitated cardiopulmonary resuscitation. Interventions' duration ranged from 25 minutes to 90 minutes.

The video recordings were analyzed with the "Captiv" software. This software allows the post coding of video sequences. Verbal interactions and actions performed were systematically coded. We measured the duration of verbal utterances and we identified characteristic sequences of actions.

We completed and validated our analysis by means of interviews with ambulance personnel. We selected some video sequences and used them as a support for the interviews. Our goals for these interviews were to better understand what we observed, and to validate some of our conclusions.

## 3. RESULTS

Tasks like assessing the patient health status requires the ambulance personnel to ask many questions to the patient (or to other people present on the intervention site – e.g. relatives, witnesses). The information considered by the ambulance personnel comes from various sources (e.g. verbal or auditory,

visual, tactile). Such information comes in an order that is not necessarily adapted to the ambulance personnel cognitive process. In addition, interruptions are frequent and can be very disruptive.

We identified and documented different key aptitudes like orientation and spatial sense, the capacity to perform complex cognitive tasks and delicate manipulations in the context of divided attention, as well as diverse aptitudes relevant in collaborative work. The knowledge of these key aptitudes is important for educational and training matters, and for the selection and evaluation of ambulance personnel. Different tasks call for different aptitudes. We use the chronology of a typical prehospital intervention to present these aptitudes.

1- Stand by: time between interventions: the time between interventions is used by ambulance people to accomplish diverse tasks including clerical work, inspection of material, updating geographical or intervention databases, etc. These tasks can be interrupted at any moment; ambulance people must be able to accomplish efficiently these duties despite frequent interruptions. Ambulance personnel must be continuously ready for the action. This causes additional psychological workload and ambulance personnel must be able to cope with it.

2- Response to a call: ambulance people receive a message on their pager specifying the patient's address, name and age, as well as the level of priority and the nature of symptoms requiring their assistance. Between the moment it receives a call and the moment the ambulance leaves the station, the crew has to anticipate the situation at the intervention site and prepare for it. For example, ambulance people could bring some additional warm cloths if they have to go on a car crash in winter; expecting to spend an extended period in the cold. They could also put on bulletproof jackets for late at night intervention in sensitive area. Ambulance people need to quickly recall learned sequences of actions they might need to implement on the scene. For example, they might rehearse mentally some rarely used procedures for pediatric cardio-respiratory resuscitation. Such mental rehearsal takes place in the emergency vehicle as the crew is on its way to the intervention site. However, it normally starts already with the reception of the message on the pager.

3- Driving to the intervention site: as they leave the station, ambulance people systematically use the map shown on the computer screen as a confirmation tool. Different tasks are performed in parallel. In addition to safely drive the emergency vehicle, ambulance people must orient themselves and identify landmarks. Radio and telephone communications are frequent. Ambulance people perform continuous driving activity accompanied by diverse discontinuous or short visual and auditory tasks (communication, orientation). They also prepare mentally for the situation on the scene.

4- Arrival on the scene: a major concern of ambulance people as they arrive on the intervention location is to anticipate and prepare for evacuating the patient. First, they must park the vehicle in order to be close to the patient without blocking the access for other emergency teams (police, firefighter, and emergency medical team). As they walk from the vehicle to the patient, ambulance people memorize the way and try to anticipate problems that could arise while carrying the patient on the stretcher (narrow corridors, stairs). A moderate physical effort is required for carrying bags of equipment and material. Learned sequences of actions are adapted to the specificity of the situation.

5- First aid, health status assessment, and choice of evacuation means: immediate care is provided to the patient. Ambulance personnel rely on their knowledge acquired in education and experience to assess the patient's health status. This assessment is used to provide adequate first aid measures, to decide if the situation requires the involvement of the medical team, and to choose whether it is necessary to take the patient to the hospital. It also determines the type of evacuation to perform. Some objective and subjective measures of the patient's vital signs and symptoms (pulse, blood pressure, temperature, skin color, etc.) are used to perform this assessment. Ambulance people also consider verbal information given by the patient or other people nearby (relatives, friends, witnesses). For example, such information might concern the patient's health history, the latest administration of medication, or recent events or symptoms that occurred. Information is delivered following a different logic from procedures and decision trees used by ambulance personnel. Thus, ambulance personnel must memorize and organize this information in order to use it. Ambulance personnel must be able to split their attention, focusing simultaneously on different information sources (patient, environment, equipment, other people, colleague) and type of signals (auditory, visual, tactile). Aptitudes related to memory, deduction, and reasoning are required. In addition, a shared understanding of the situation enables the crewmembers to have efficient exchange of information.

6-Evacuation of the patient: the decision to take the patient to the hospital, and the choice of means (assistance by walking, chair, stretcher) used to transfer the patient to the ambulance is crucial. Ambulance personnel consider for example the patient's health state, stability, pain experienced, individual characteristics (weight of the patient), accessibility of the scene, etc. A mistake at this step can have life threatening consequences for the patient. Using the stretcher to carry the patient to the ambulance is sometimes characterized by an intense physical effort. The monitoring of patient's vital signs can be carried out in continuous during this activity.

7- During the journey to the hospital, the ambulance personnel maintain a continuous monitoring of the patient's vital signs. Conversations with the patient who often needs to be reassured and comforted are frequent. In addition to the necessary division of attention, ambulance personnel must find the right words and treat the patient with compassion. The ambulance personnel systematically communicate to the hospital the estimated arrival time, as well as a short description of the patient's state.

8- Handover of the patient to the emergency staff: the transfer of the patient from the ambulance stretcher to the hospital stretcher is only one part of this step [10]. All interventions also include a short verbal communication between the ambulance personnel and the hospital's emergency staff. Information is given in a structured and brief manner. Ambulance personnel also write a short report using a pre-defined form. Performing these tasks requires communication aptitudes allowing to choose and summarize the relevant information.

Ambulance people mentioned that our list of key aptitudes corresponds well to what is required by their work under normal conditions. They mentioned that interventions we observed were not exceptional. Thus, we did not observe key aptitudes required in very exceptional interventions.

Communication between people (crew members, patient, physician, witnesses and relatives) on the scene appears crucial.

As suggested by [11], studying the coordination process and its modalities in an emergency situation is relevant for both theory and practice. Our intervention is an example of possible way to study work activity in emergency situation.

Ambulance personnel must gather diverse information, use complex algorithms and decision trees in order to analyze the situation, and take some vital decisions accordingly. These work characteristics imply diverse requirements in terms of skills and aptitudes. Consequences for educational curriculum, vocational training and personnel selection are important. We think that better understanding cognitive and cooperative aspects involved in emergency situations will become an important issue. It also suggests that it is relevant to perform further study of work activity in its real context.

#### 4. CONCLUSIONS

Analyzing work activity in the context of real prehospital emergency is challenging but feasible. Our study highlights the richness of cognitive processes involved in prehospital interventions. Better understanding these processes can help to improve training and education of ambulance people. Aptitudes such as orientation and spatial sense, the capacity to perform complex cognitive tasks and delicate manipulations in the context of divided attention, as well as diverse aptitudes relevant in collaborative work seem very important. Building selection tests as well as educational material taking into account these aptitudes are relevant.

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