

## [2052] The emotion of light instrument for wellness

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If objects have the ability to talk, if environments have the chance to get around this, it is definitely due to light. If this is spontaneously accepted less spontaneously we accept that objects and environments have their own autonomous experience with whoever uses them.

Yet in them there are phenomena that do not depend on the wishes of the user, but rather express conditions that suggest moods, purely emotional perceptions.

The logic that wants the isometry of the form to determine functions or uses is often a logic of perceptual suggestions, relational relationships between light and shadow. Light not only illuminates but characterizes shapes and spaces. Not only does it allow perception, but it is through it that emotional relationships arise. Objects, spaces through light modulation, chromatic declination, and tonal intensity, offer varying dimensions of fruition.

It is an example that if physical space is always equal to itself in time, luminous space can change and transform perceptual conditions by cognitively altering and even suggesting the psychological relationship of the use of things.

Designing the light today also means refining the approaches to the discipline by adopting training pathways that can interact in close co-operation both with the design of physical parameters and with the intangible content project.

To this is added education to perception as a cultural structure. As Arnheim has already largely argued, perception requires time and in this need to be educated to be aware of it.

According to Arnheim, our perception, in the general sense, is not differentiated beyond what is necessary. That is to say that the concepts are so generic as it is allowed by applying them to understand what you are observing.

To perceive an object as unchangeable means to move it to the highest possible level of generality. In the physical world, however, the modifications exist. The control and design of this variability condition greatly contributes to the comfort of fruition to be more in line with what we actually see, otherwise everything will remain motionless enough to suggest that variations either do not exist or do not matter, thus renouncing emotional sensory.

On this increased awareness, accelerated by the evolution of technological possibilities, new aspects of the light project are being developed today. Now skilled in scientific hardship, the lighting designer needs to draw on the sweet sensuality of light as a research tool for visual comfort before even as a method of rationalizing perceptual cognition.

The new dimension of designing light overtake, with the support of increasingly sophisticated implementation tools, the commitment to make a correct contribution to

lumens by expanding the lighting design to a strongly cultural trajectory: educating well-being by educating the perception of light.

## **[2090] Language issues in the activity of interaction with the company players: Building tools to guarantee a 'common ground'**

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### **Symposium: Ergonomic analysis of work activity and training: evolutions of basic paradigms and creativity in practices**

Quite often companies from different economic sectors ask for the intervention from research groups connected to the fields of Ergonomics, Production Engineering or Work Psychology, both in Brazil and in Portugal. In certain situations, those requests unfold in new demands.

The attitude we adopt as consultants to answer those requests privileges a clinical approach. Consequently, we value the coproduction in context, both for the meaning and for the experience brought to work (Jobert, 1992). We advocate the development of a reflexive contract between the consultant and the client, given the adoption of a collaborative attitude (Falzon, 2007), with constant changes, making it possible to reach a commitment that satisfies both parties.

The thoughts led by Catherine Teiger and Antoine Laville (2013) since the last decades of the 20<sup>th</sup> century on the relations established between 'training-research-action' were already defining the matrix of this stance. Indeed, it was already acknowledged that such relations are built upon the confrontation between different modalities of knowledge (the workers' knowledge, experts on the work situation, and the researchers' knowledge). It was then underlined the need to gradually master a common language on the activity, which would allow the development of a mutual understanding between researchers/trainers and workers.

Actually, analyse the language-related issues throughout the interventions and along their evolutions seems to help understanding the uniqueness of the actions that end up being developed in the dialogue with the requesters at the companies. In addition, in all the cases that have been assessed, there seems to be an obvious quest for the gradual constitution of a 'common ground' (Re, 2013). The effort for that construction happens throughout the intervention, and that movement includes linguistic concessions from both parties, that is, not only from the company experts, but also from the research experts. In such a way that there is the mutual appropriation of vocabulary, diverse audiovisual codes, signs, symbols, etc. It is then noticeable a certain plasticity in the choice of the tools to be used during the interventions to guarantee they fit not only the contexts, that correspond to the training-intervention objects, but also the evolutions of the common understanding.

This framework reverberates with experiences lived in researches-interventions in Brazilian and Portuguese companies and the thoughtful analysis we will lead does not

prioritise the tools built from the analysis of the operators' activity; instead, it highlights and shows what leads to the dialogical relation with the requesters.

**[3294] From diagnosis and recommendation to a formative intervention:  
Contributions of the Change Laboratory**

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**Title: “From diagnosis and recommendation to a formative intervention: Contributions of the Change Laboratory”** <sup>[1]</sup>

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The analyses of organizations using the Work Ergonomic Analysis methodology make an important contribution to the understanding of present-day situations and serve as a basis for ergonomists' recommendations for the transformations of the work situation. However, this approach does not give the necessary emphasis to the historical analysis of the activity system, having as its presupposition that the understanding of the present is sufficient to reflect on and foresee the future. These limitations can be observed in other participatory approaches.

**Objectives:** To show how a historical analysis can be used to redesign the relationship between a School Health Center (SHC) and the School of Public Health (SPH). **Methodology:** This paper used the data and results obtained from the Change Laboratory (CL) intervention case which occurred in the SHC which is part of a SPH in the State of São Paulo in 2015. The double stimulation strategy and tools used during the CL sessions, which served as first and second stimuli and produced concrete results and learning were revisited.

**Results:** A timeline was collectively constructed, helping to visualize which the historical events involved were and how they contributed to creating the contradictions which led to the crisis in the relationship between the two institutions in their present activity. In 1925, the SHC was created as a learning space for the students of the SPH. Changes in curricula, isolation of the service from the Unified Health System (SUS) and an emphasis on research led to the distancing of the School from the Service. This process of estrangement was aggravated by financial difficulties. During the collective analysis of the historical development of the activity system, both the participants and the

researchers expanded the way in which they understood the crisis and its possible solutions, identifying the sources of the conflicts faced in the activity. **Conclusions:** In order to understand and intervene in the activity it was necessary to clarify how and why the activity system developed and became what it is. This is a starting point to learn how to manage the dynamic of a situation rather than permitting oneself to be driven by it. The participants from the SHC and the School were better able to understand the reasons for the present situation, and based on this understanding were able to visualize alternatives for the future. A lack of understanding of the past can harm the construction of sustainable solutions for the future. The CL methodology demonstrates the value of the participants' completing the expansive learning cycle. The empirical and historical analysis is a powerful tool for redesigning the future and to ensure enabling interventions.

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⌚ Symposium: "Constructive ergonomics: enabling interventions and related methodological issues"

## [1886] The importance of considering women in manual handling studies

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Introduction: The integration of women into typically male workplaces is becoming more prevalent. This integration is not without risk for women, especially when this work has a significant physical component. Traditionally, MMH is largely performed by men, and this has certainly contributed to the limited presence of women in MMH studies. It is not known if the findings of studies with male subjects can be extrapolated to females, considering they are smaller in size and less strong than males. Female handlers face different challenges than males that must be understood so as to avoid exposing them to higher physical risks. A study was undertaken to better understand the differences between males and females in transfers of boxes between palettes.

Method: Three groups of subjects participated in the study: 15 male experts, 15 male novices and 15 females. The tasks consisted of transferring 24 boxes of 15-kg from one pallet to another at a free lifting pace and at a forced pace of 9 lifts/min. Then, after a 30-minute break, the females had to repeat the transfer with boxes of 10-kg. The participants were instrumented in such a way that a dynamic 3-D linked segment model was used to estimate the net moments at L5/S1. Female were compare to male with the same absolute load (♀ and ♂ =15 kg) and with the same relative load (♀= 10 kg and ♂ =15 kg), knowing that females' back strength is approximately 66% of males strength.

Results/discussion: It was hypothesized that the lifting technique used by female workers would be equivalent to those of males when the relative load is similar. This was true for some variables such as task duration and cumulative loading, and partially true for variables defining whole-body posture. However, a different sequential interjoint coordination pattern was seen between expert males and females with both the absolute (15 kg) and the relative load (10kg) suggesting the influence of factors more intrinsically linked to sex. This type of research is essential because some authors suggested that the findings of one sex might be used as an accurate representation of lifting technique for the other sex once actual load factors are taken into account. The present research showed that was not the case and demonstrated the importance of including both males and females in studies of manual handling.

It is not a business case

## **[2626] My Pain Coach: a Mobile System with Tangible Interface for Pain Assessment**

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Pain assessment is the foundation of pain management. However, measuring pain is challenging and the main approach is based on self-reporting. A broad range of self-report scales is currently available to assess pain in the elderly. In these scales, the most frequently assessed component of pain is pain intensity, which is usually measured through the adoption of Visual Analogue Scales (VAS), Verbal Rating Scales (VRS), Numeric Rating Scales (NRS) and Facial Pain Scales (FPS). The tools for pain assessment based on these scales were usually developed under the form of paper questionnaires. However, the democratization of computational technology, the introduction of mobile devices and the almost ubiquitous connection to the Internet impacted also on the way of developing these tools. Indeed, the recent scientific literature presents a plethora of technological implementation of pain assessment tools. The main solutions can be categorized in two main groups: websites and smartphone applications. Although several different types of graphical interfaces exist with relative advantages and disadvantages, this kind of modality of interaction is exclusively founded on digital images and touchscreens. Unfortunately, this interaction modality is not suitable for everyone and this limits accessibility and usability.

In this paper, we will present a novel mobile system based on a smartphone with sensitive touchscreen and a connected tangible interface. The smartphone features an Android application that allows the user to create a personal diary for regular monitoring of the pain levels and the associated symptoms in everyday life. The mobile application allows creating infinite entries, each time the user has to answer some questions about her status and symptoms. Then, the application asks the user to specify the intensity and location of the pain. As already mentioned, this mobile system provides two different interfaces: the first one presents a digital mannequin (with front and back) and the user can directly tap on the touchscreen to locate the pain on it; the pressure of the tap measured via the force touchscreen provides the value for the intensity of the pain. The second interface is based on a flexible mat made of textile, which has the mannequin directly depicted on it. The user can press the finger on the mat to locate the pain and the pressure provides the information about the intensity of the pain. The information entered via the tangible interface is simultaneously sent to the mobile application via Bluetooth.

The final paper will present the system more in details depicting both the architecture and the application screenshots. Moreover, the study conducted with 7 users will be described and its results discussed.

## [3271] Professional Ergonomists Education: lessons learned from worldwide existing programs

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Title: Professional Ergonomists Education: lessons learned from worldwide existing programs

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This research is the result of a collaboration established between ergonomists from all over the world that are concerned with education of professional ergonomists. We have started a collective state of the art of ergonomics training programs for professionals, according to IEA standards. The team that organizes this symposium - all ergonomists, teachers, researchers and practitioners in the ergonomics discipline - has already started this research and published it at SELF Congress 2017, and continued working in new results from other corners of the world.

We have started the project by addressing a mail to all the federated societies as they appear in the IEA website, to some of the IEA executive committee members, and finally contacting the ergonomists we know are or were directors of master degrees in ergonomics all over the world. We asked them to give us their feedback through some questions concerning the education program in which the consulted ergonomist has been involved.

The stake is to deeply understand the training case through the answers to the questions sent. For the moment we got the answers of 14 countries, and more than 20 education programs. The results showed that:

- § Many ergonomics/human factors education programs are taught in different universities around the world.
- § Some of these programs are quite new (less than 5 years of existence), others emerged from older programs due to the adjustment process of the scope each program.
- § Causes of adjusting scope of education programs are: (a) needs of industry in terms of highly trained ergonomists, (b) demands of students, (c) pressures of the university to adjust to constitutional constraints
- § Challenges facing education programs are: (a) Lack of awareness of ergonomics among stakeholders (b) Lack of industry support for the discipline (d) recruiting students to graduate programs (c) Lack of experienced HF professionals who could be engaged to teach in the programs.
- § Permanente marketing of Ergonomic /HF programs are essential for their success.
- § To be in charge of an ergonomics education programs is stressful in situations like: (a) being the main faculty member with ergonomics expertise (b) lack of awareness of ergonomics among stakeholders

We hope this research will add our "grain of sand" in the necessary collective work of IEA's "Professional Standards and education standing Committee".

## [3753] The Culture of Innovation: Needs and Opportunities

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Symposium: 24U – Plurivers Design

“The Innovation Culture”

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At such a peculiar historical time as the one we are currently living in, companies strongly ask for “innovation”: innovation of product/service, innovation of processes, innovation of the business as a whole. Such need might arise from far-sightedness, curiosity or from concern, always and in any case, from a discomfort of inadequacy of what already exists.

When the management perceives this need, if it is motivated and real, they are seldom aware of the fact that the change will involve questioning not only products, methods and processes, it is, however, rather the culture and the company values that require to be innovated.

In my experience, these have been the exact obstacles to the redefinition of the business, as culture represents mental models of the people constituting the organization and influences the way events are seen by those people, how they react to such events and the way the outcomes from carried out actions are perceived and re-elaborated.

In short, culture results from our knowledge and experiences.

By definition, the drive towards innovation is oriented to the future, to something that does not exist yet, that is only perceived but not yet understood. Therefore, if there is no awareness of the desired future situation, the established models and processes cannot be of help, even though in the past they had turned out to be the winning strategy for the existing business.

In the proposed case, we will try to show what actions need to be carried out, in order to promote and facilitate useful culture changes for the innovation processes. Particular attention is addressed to the criteria of conception and of construction of “suitable” spaces, both physical and temporal, such that all the company, starting from the leader, could become more aware. Aware of new

paradigms that allow to implement new business, of new ideas designing methods, of new evaluation and acquisition criteria of the resources, both technological and human (competences), of the concept of customers “that are not yet concrete”, in order to think over and build real “prototypes” of a possible new business, of a “new company”. The prototype creates the necessary training experience for a new culture that can be passed on and shared thanks to the leader, main “architect” and beneficiary of the outcoming results.

Leaders build the sense of an organization through vision and mission; however, companies live, work and survive thanks to a suitable culture that supports the path designed by the leader.

## [1993] Wearable devices and smart garments for stress management

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Wearable computers and smart garments are the cutting-edge of electronic devices; as they are miniaturized, people can directly wear them, generating a continuous interaction between user and computer. The implementation of wearable technologies in everyday life is going to change completely human behaviors. These devices creates human-computer interaction potentialities that can be addressed to several directions: helping and taking care of people, leading people to a different behavior model for changing social dynamics, turning these ubiquitous computers into a “collective wearable”, a system of interactive digital personal assistants, which is extended worldwide.

Simultaneously, there is a global adoption of the preventive approach to health: it consists of measures taken for disease prevention, as opposed to disease treatment. The preventive healthcare and the *anti-aging* strategies have been developed according to the OMS definition of Wellness:

*“Wellness is the optimal state of health of individuals and groups. It is a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity. Wellness is a conscious, self-directed and evolving process of achieving full potential”.*

. There is also an increasing attention to the security and to the risk management in the sanitary field in terms of products, ergonomic communication and innovation of processes. Moreover, users demand to know their real wellness status, independently of the individual perception. It is necessary to inform users about the biofeedback recorded by wearable devices, but it is essential to effectively communicating them to caregivers or patients.

In this context, design can be a strategic driver to inspire technological innovations and to turn them into new product typologies, giving an interesting point of view for the problem solving and for the problem setting.

This paper, presenting some of the result of interaction design projects for human wellbeing and healthcare, explores some tangible interfaces focused on biomedical and clinical fields: they concern the security, the stress management, the collection of biofeedback for preventive healthcare and also emotional issues connected with the human-computer interaction.

**Keywords:** Wellbeing, Interaction Design, Internet of Things, Smart Garments, Wearable computers.

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## **[3750] The RESOLUTE Project: Guidelines for Resilience Control Room design in the Smart Cities**

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### **The RESOLUTE Project: Guidelines for Resilience Control Room design in the Smart Cities**

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### **Background**

RESOLUTE is based on the vision of achieving higher sustainability of operations in European UTS. The project recognises foremost the ongoing profound transformation of urban environments in view of ecological, human and overall safety and security needs, as well as the growing importance of mobility within every human activity.

RESOLUTE considers resilience as a useful management paradigm, within which adaptability capacities are considered paramount. This led to the creation of the European Resilience Management Guidelines (ERMG), aiming to support cities in developing the right capacities and monitoring the resource availability to sustain its adaptive capacity. To this end, the ERMG development has adopted a system's perspective, by applying the Functional Resonance Analysis Method (FRAM) to model a generic CI and to identify which are the desired functions and the related interdependencies that should be managed towards the improvement of resilience in a CI.

### **The ERMG operationalisation for Resilience Control Room**

The ERMG were operationalised exploiting big data generated by Smart City features. The main outcome is represented by the Collaborative Resilience Assessment and Management Support System (CRAMSS). The CRAMSS aims at improving the communication among involved actors, including organisational decision makers and citizens.

The growing complexity of socio-technical systems requires a shift from centralised decision making to distributed and collaborative decision making. To this end, cooperation and coordination mechanisms become fundamental, namely between multiple operational control centres of CI stakeholders. Control room systems and processes design becomes fundamental to ensure accurate and context related flows of information (both pull and push).

### **The Resilience Control Room design recommendation**

The development of CRAMSS and all the related RESOLUTE outputs were steered by a set of information and control room design principles. These can be summarised as follows:

- Suitability for the task's nature and performance conditions
- Self-descriptiveness (being self-explanatory)
- Controllability

- Conformity with user expectations
- Error tolerance (ability to reverse and correct decisions)
- Suitability for customisation
- Suitability for learning

These systems requirements were called on throughout project development and they reflect on project achievements. From a resilience perspective, human centred design principles are fundamental to ensure that human operators and, in the case here addressed, decision makers at control rooms, are able to cope with complexity and uncertainty towards enhanced adaptive capacities within the operation of CI.

**Project Website:** <http://www.resolute-eu.org>

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## **[3267] Education and Training of Ergonomists at Aix-Marseille University (AMU)**

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### **Education and Training of Ergonomists at Aix-Marseille University (AMU)**

**Aix-en-Provence, France**

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The content of the education and training in the professional and research Master specialized in Ergonomics was developed on the basis of the European and international requirements for professional ergonomists.

It trains professionals to be capable of carrying out ergonomic interventions aimed at optimizing workers' safety, health and well-being as well as the efficiency of production systems, through the combination of cognitive ergonomics, organizational ergonomics and physical ergonomics. It also allows to train ergonomists that have competencies in activity analysis, in the design and evaluation of workstations and user interfaces, in UX design and in ergonomics approaches related to new technologies of information and communication (e.g., virtual reality, robotics acceptance, and so on).

During the 1<sup>st</sup> year students follow theoretical and practical courses related to human work and activities and they have to realize both a 1<sup>st</sup> internship in a company and a research work on a topic in Ergonomics.

During the 2<sup>nd</sup> year students acquire methods and techniques of work analysis/activity analysis, work environment analysis, adaptation to workers/operators, safety and risks management, user interface design and evaluation, UX design as well prospective ergonomics. They have to participate in tutored ergonomic interventions in response to a (real or simulated) request from a company or based on establishments defined by the professors, which lead students to progressively adopt a 'professional posture'. Finally, students have to do another research work in Ergonomics and to perform a 6 months internship in companies. This work is supported by groups of regulation to engage students in reflective practice. They result in written reports and oral presentations, with a committee composed of both professors and professionals.

### **Difficulties encountered when creating the program**

It has been difficult to obtain the Department's recognition of the importance of having professors who are specialized in ergonomics psychology and ergonomics and the formal recognition of Ergonomics as a disciplinary.

We observe a major work overload for the main professors who intervene in this program Obtaining the support needed to create new positions for professors specialized in ergonomics is a second issue.

### **Positive aspects of the development of the program**

Since its creation, this program has been improved to correspond to European and international standards for training programs in Ergonomics.

Most of the students who get their diploma are directly hired by companies at the end of their internships.

This Master's program is associated to the laboratory PSYCLE and it benefits from the use of numerous equipments that are available in the UserLab, such as eye-tracking, systems of movement and facial/emotions analyses, and data capture and analyses.

### **More information about the program**

<https://centrepsyycle-amu.fr/master-ergonomie/>

# [3748] The Development of resilience management guidelines in the DARWIN project

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## The Development of resilience management guidelines in the DARWIN project

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### Background

H2020 project DARWIN aims to build resilience management guidelines to support organisations in developing and enhancing their resilience in the context of crisis management. During the first 6 months of the project, a vast review of associated literature, standards and operational documentation, as well as interviews of practitioners, was undertaken. A significant number of requirements were identified to guide the subsequent development of the DARWIN guidelines. Those requirements included especially conceptual requirements that captured resilience management capabilities the guidelines are addressing. The presentation will describe the nature of the guidelines, the process of their development and its results, achievements and limitations.

### Nature of the DARWIN Resilience Management Guidelines (DRMG)

The context is that of organisations that already have a number of processes and tools in place to support their management of crises (e.g., preparation activities, contingency plans, procedures, learning activities). As a result, the guidelines are positioned at a meta-level: rather than replacing them, they provide an approach to adopt a critical view and revise or develop such processes and tools. Such view is based on research and practice on resilience management inspired by the fields of Resilience Engineering and Community Resilience.

### DRMG development

The guidelines' development follows a 4-step process established to be collaborative and iterative, and to include operational input early and as often as possible. The process changed and solidified during the course of the project as a result of the evolving understanding of what type and content of guidelines would be useful to develop and of how to produce such guidelines while fulfilling the various objectives of the project.

The following points are essential aspects of the development of the guidelines:

- The building blocks are individual pages that address specific topics about resilience management and propose interventions in order to develop and enhance the corresponding capabilities captured in the conceptual requirements. They are at the heart of the guidelines development process described in this document. As a whole, the guidelines build on the topics by organising and relating them, because the capabilities they refer to are not independent.

- Operational perspectives are incorporated through the participation of end-user practitioners and experts from Air Traffic Management, healthcare and other Critical Infrastructures as co-creators throughout the development life-cycle.
- A Knowledge Management platform facilitates the development, management and use of the guidelines. The platform offers opportunities to reconsider common views on the nature of guidelines, their necessary evolution and their multi-faceted, multi-purpose content.

**Project Website:** <https://h2020darwin.eu/>

## **ACKNOWLEDGEMENTS**

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## [1541] Visual and cognitive errors in Radiology

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Radiology is characterized by the presence of all the activities connected to the other disciplines, with the risks connected to the surgical activities, to the administration of drugs, to the diagnostic activities, to the management of complex machinery, to the communication with the patients, to which are added the risks related to the diagnostic use of ionizing radiation.

Its role in the diagnostic-therapeutic pathways is of primary importance.

From the imaging process derive a huge part of clinical decisions.

Those considerations places the radiology at the center of the processes that influences the outcomes of the treatment.

In all disciplines it is necessary to build procedures that protect against mistakes and many of them are shared with clinical radiology.

However, the role of perception and of the correlation mechanisms between images and pathologies is peculiar for diagnostic imaging, too often considered an automatic process.

The diagnostic process is Instead subject not only to the quality and quantity of knowledges, but as well, and above all, to cognitive mechanisms, that drives image transformation into clinical diagnoses.

## **[1412] Gesturing on the Handlebar: a User-Elicitation Study for On-Bike Gestural Interaction**

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Technology is becoming pervasive and it started to play a crucial role also for professional cyclists.

Several mobile and wearable systems to track performances, share information and enable communication already exist.

However, the interaction with such system is still based on pressing buttons or through touchscreens. Often, the screen of these systems is placed on the handlebar, allowing checking the information in a convenient manner. However, every time the user has to interact with the system to change parameters, she has to take at least one hand off the handlebar and press a button or touch the sensitive screen. This action can be dangerous and can distract the athlete, who has to keep her focus in order to maintain good performances. Gestural interaction can be a valid alternative to the more classical interfaces. In particular, it is worth exploring the possibilities of developing a system that can enable the cyclist to perform gestures while keeping the hands on the handle bar.

This paper presents a gesture elicitation study aiming at discovering the most convenient and ergonomic gestures that professional cyclists would like to perform in order to interact with a screen on the handlebar.

Gesture elicitation is a technique that emerges from the field of participatory design. End users are individually shown the desired effect of an action (called a referent) and asked to propose the gesture (called a symbol) that would bring that effect about.

The final paper will report the design study conducted with 7 professional athletes in collaboration with a popular brand of professional bikes. The results show which are the most convenient gestures associated with specific functions for the interaction with a mobile phone application for the monitoring of the user's parameters and some optional features. Complete freedom has been given to the cyclists to perform any gesture in order to control the application remotely. Users could choose to perform gestures anywhere on the handlebar, with either hand and in any valid way. Further analysis will present also which are the most used categories of gestures, the number of fingers used for each gesture, its correlation with the gesture categories, the use of hands with preferred posture, and the spatial reference on the handlebar. The final version of the paper will include the tables reporting all the values recorded during the test and the images depicting the most important gestures performed by the participating athletes.

The discussion will highlight the correlation between the use of hands and the target function for the interaction with the smartphone application. Furthermore, a short comparison with similar studies, such as gesture elicitation for gestures performed on a steering wheel, will be added.



**[1772] Impact of new technology on job design, skill profiling and assessing the physical, cognitive and psychosocial impacts on the workforce. Part of the Symposium Implementation of Robotics and affecting factors.**

David Caple<sup>1</sup>

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The introduction of new technology into the workplace has been associated with the reduction of safety risks where hazardous tasks have been eliminated. For example, the use of robotics and mechanical aids in manufacturing and warehouse logistics eliminates repetitive manual handling tasks. The business case for investing in this technology is based on a reduction in labour costs, including reduced injuries as well as an improvement in productivity and the quality of pallet stacking. The potential for using robots to reduce risk to humans is dependent on the capacity of the industry supply chain particularly where manual labour is required to handle the product. For example, in the supermarket industry the robots can be used to stack product in the factory efficiently to a height determined by the reach of the robot. However, there are limiting factors in the supply chain to how high the pallet of product can be. These include the size of the trucks used to transport the pallets to the distribution centre; the height of the racking bays in the distribution centre; and the capacity for the workers to manually unload the pallet to meet the orders for the supermarket shelves. All these factors influence how high the pallet can be stacked by the robot. Whilst the new technology involving robots can reduce manual labour and risk of injury to workers at the factory the robots cannot be utilized to its full potential if it is limited by other factors in the supply chain.

The reduction in manual labour jobs in industry by utilizing robots is associated with an increase in jobs requiring skills in STEM (Science, technology, engineering and mathematics). The workers with these skills are required to install, program, maintain and trouble shoot problems with the technology to ensure sustained reliability. There are more semi-skilled jobs required to operate the materials handling equipment as the product is moved through the logistics process. The cognitive and psychosocial skills required for these jobs include the ANTS (Associated Non-technical Skills). These include skills in situational awareness; teamwork; decision making and task management (Flin et al, 2012).

The role of the ergonomist is to assess the impact of technology and work systems on the workers. This requires a broad set of technical and communications skills. Their role is to provide guidance on the physical, cognitive and psychosocial requirements to ensure the health and wellbeing of the workers. This role requires close engagement with members of the multidisciplinary teams who are designing and implementing the technology.

The long term impact of this technology and changing ways of working require further research to assess the physical and psychological impact on the workers.

**Keywords:** Technology, skills, physical, cognitive, psychosocial, workplaces



## **[1334] Difference in risk perception and decision making of mountain guides: the role of observation and interview to question gender approach at work**

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**Aim:** The aim is to understand the link between risk perception and gender in the profession of mountain guide. This risky profession has become more accessible to women over time. And, it is related to a very high accident rate and is characterised by a customer relationship (guiding people with disparate experiences and skills in the mountains) which can involve the guides responsibility in case of an accident.

The question is about the collective risk management between guides and clients, guides and other mountaineers, and, guides and different organisms (agencies, ...). Indeed, the whole works environment is changing with global warming and the evolution of society, which induces an intensification or new perception of risks. Many modifications in the training have been done as well as in the safety equipment. But we know that the decision making in the action is preponderant for the risk management. So, we're trying to better understand in this context, how the gender can be an effect on decision making process.

**Method:** Our research based on twenty interviews, is completed by the accident statistical data analyses. The study concerned the comparison between two guides, one male (36 yo, 2 years' experience) and one female (33 yo, no experience) on the same route in Mont Blanc mountain. Two cameras allowed us to catch and record the behaviour of the guide and the communication with his clients. The two interviews which followed each observation, the first one, just after (to identify the key moment of the day) and the second one, ten days after (with the video), helped us to confront the guide with his own activity. The next step will be a cross-discussion between the guides, and it is about to be planned.

**Results:** In the interviews, it seems to appear that most of the guides have the same representation of the main risks as well as they are aware of the difficulty of the decision making in their dynamic environment. However, we noted differences on sexe/gender, between the male and the female, in the way they manage the safety. We also noticed these differences during the observation, in particular in the preparation, the diagnosis of the client's skills, the management of materials and the risk perception. We also observed that together, the female and male guides pass other mountaineers even with a risky behaviour and to finish the route as quick as possible.

To conclude, some methodological innovations could be expected to question the way the guides handle the risk management, particularly in relation with their own characteristics like sexe/gender.

## [3289] Co-constructing organizational autopoiesis:

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Co-constructing organizational autopoiesis:  
the Developmental Laboratory as a model and means of enabling interventions

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This paper describes a participatory intervention aimed at redesigning organizational processes in the railway sector. The intervention took place after an attempt at insourcing part of the subway maintenance activity. The techno-centred management of the change resulted in a decrease in organizational reliability and performance. The intervention focused on the sustainability of the organizational development.

The intervention is grounded on assumptions regarding the nature of organizations and on the means and purpose of participatory interventions on organizations.

- Organizations as self-designing systems.

Organisations are not seen as stable structures, imposing rules, norms and procedures. Organisations are seen rather as a permanent process of regulation between various actors defending various interests (Weick, 1977/2012; Feldman, 2000; Hernes, 2008, 2010; Hernes & Maitlis, 2010; Tsoukas, 2009; Tsoukas & Chia, 2002). Notably, organisational processes result from a collective sensemaking, which means that agents produce “organizational work”. In this view, a very important role is given to organizational actors as creator of their work practices.

- Enabling interventions

In the above perspective, ergonomic interventions aim at facilitating "design-in-use" processes, so as to empower agents. Thus, the objective of ergonomic actions is both to foster processes of development throughout the ergonomic intervention and to design work systems that promote development. Enabling interventions integrate development as a means and as a purpose.

Following this view, intervening means setting up, during the intervention itself, a dynamic apparatus that encourages the explicitation of and the debate about the multiple representations of work. Thus, intervention is seen as a pedagogical process of change that allows actors to learn and to develop themselves and their processes. Development is a means of the intervention.

The entire intervention was conceived as a “Developmental Laboratory” aimed at empowering organizational actors to construct and set in motion autopoietic mechanisms, i.e. mechanisms allowing actors to permanently redesign organizational processes to suit activity requirements. The constructive dimension of the activity (learning) is taken as a lever for organizational development.

Thus, the enabling environment set up by the ergonomist is a success factor both in managing change and in actors and processes development. A post-hoc reflexive analysis reveals the conditions of such a developmental intervention strategy and the multiple roles played by the ergonomist as an organizational change manager.

Key words: organizational autopoiesis, Developmental Laboratory, participatory design, enabling interventions

## **[2450] The phenomenon of self-medication in active workers: Self-medication, gender and work**

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Self-medication can be understood as one of the main actions of self-care performed by the human being, ingesting, either on its own initiative or on the advice of a close person, some type of free-access medication, which is usually done before a symptom, a slight health problem or some alteration in the organism. An instrument was designed that consists of three parts: sociodemographic and contextualization aspects; The respondent's position on self-medication and different behaviors that compose it is explored through 20 statements. Finally, the scale of Social Support of Sherbourne and Stewart (1991) was used to know how to make a relationship with the scale of self-medication; this last scale consists of 19 statements, to which they give a response on a Likert scale. We worked with a sample of 35 people, where there were 26 women (74.3%) and 9 men (25.7%), with ages between 22 and 62 years, were people working actively in flower cultivation, while 62.9% (22 participants) were people who held different positions in the mayor's office of a city hall.

Self-medication and its practices are a phenomenon that can lead to different risks, both personally and socially in the individual. A person may not be aware that he is currently self-medicating, but his self-medication practices are evident; the study was evidenced in item 14 of the first part, since only of the 9 people who have self-medication practices, only two reported taking medications.

There is a high consistency with the other studies reviewed, leaving aside the methodology used in this study, since as it was evidenced in the results, of the 9 people who have self-medication practices, 5 are women. On the other hand, in terms of place of housing, it was evident a high level of self-medication practices in people living in urban areas, this may be due to the increased ease of access to different media to perform this type of practice, either to the doctor, to the mass media or to the drugstores.

It was demonstrated in this study, where there is a higher level of self-medication practices, it is in the people who are already professionals, this can also be due to the acquisition of different knowledge and also the ease of understanding the usefulness of different medications, both natural and pharmacological. The most common practices in the population involved in this study was that they knew a wide variety of home remedies for any pain, discomfort or disease, they also know the side effects that can be generated by some medication when taking it on their own initiative.

## **[1717] Gendered indicators in OHS: a number to convince and transform public policies**

FLORENCE CHAPPERT<sup>1</sup>

<sup>1</sup>*ANACT, LYON, France*

In 2009, Anact's joint Board backed by the Women Rights and Equality Department decided to introduce gender approach in methods for the improvement of working conditions. Hypothesis which was made at that time was that prevention of some occupational health problems could improve understanding and undertaking different working situations between men and women.

### **Some statistics which influence public policies : more and more working accidents for women for 16 years**

Since 2012, Anact has published a sex differentiated statistical analysis of working accidents and recognized occupational diseases. The last statistic photograph published in 2017 reveals that although women suffered half as many accidents as men in 2015, the drop over 16 years in the number of working accidents (reduction of 16% between 2000 and 2015) masks asymmetric evolution between the sexes, namely a decrease of 30% for men in all sectors of activity, compared to an increase of 33% for women, particularly in those sectors where women predominate.

In sectors like medical, healthcare and social sectors, but also bank / insurance or trade / retail, the fact is that women started recently in jobs exposed to risk factors inadequately assessed and recognized, and in a context where occupational health prevention policies do not seem to be effective enough for the activities carried out by women.

### **Another framework « whereas, everything is not equal»: a key understanding of health inequalities between men and women**

Anact-Aract's network's interventions in companies have allowed progressively to build a framework for analysis occupational health inequalities between women and men with four areas of analysis : work organization and gender mix, working conditions, career paths and working time.

All of this elements can explain different effects of work on health for men and women.

### **New laws for companies**

Anact network studies have lead to legal evolution. The Act on Real Equality between men and women was adopted in France on August 4th 2014 with the obligation for companies to define gender indicators in occupational health and security and the obligation to carry out « risk assessment » which takes into account sex differentiated impact of exposure to risks. The Modernisation Act of the Health System in 2016 requires that occupational health doctors have now to carry out every year in their report gender data analysis.

These new measures should allow for the adaptation of work organization and prevention policies for a better health at work for women and men.

This encourages companies to put in place health and safety policies which use « gender glasses » so that progress in prevention or promotion for quality of life is made for everyone, regardless of gender.

## **[917] How holistic approaches of activity analysis in ergonomics renew training design?**

Vidal-Gomel Christine<sup>1</sup>

<sup>1</sup>*Université de Nantes, Nantes, France*

### **Symposium: Ergonomic analysis of work activity and training: evolutions of basic paradigms and creativity in practices**

#### **How holistic approaches of activity analysis in ergonomics renew training design?**

Vidal-Gomel (Univ. Nantes), C. Delgoulet (Univ. Paris 5), V. Boccara (Univ. Paris Sud) & D. Cau-Bareille (Univ. Lyon 2)

This communication will present the benefit of holistic approaches of work analysis in ergonomics and professional didactics in the field of occupational training (Boccara et al., 2015). These research-intervention processes had the originality aiming to conduct jointly learning questions, conditions of training and prevention of occupational risks. This originality will be presented from two research-interventions in the field of agriculture and aeronautics industry.

**The first study** mixed ergonomics and professional didactics methods. It analyzed a workplace training in which an expert animal handler trained two colleagues who had to learn a new task: the late gathering of bovine embryo. The training scheme initially implemented in order to facilitate the transmission between the workers have been transformed to face specific difficulties that emerge during sessions: the context demonstrates certain psychosocial risk factors (Van Belleghem et al., 2014). They conflicted with the training objectives and must be overcome. The combination of the ergonomics and professional didactics framework allows to underline that on-the-job training offers genuine learning opportunities while also possibly involving real pitfalls and exposing the trainees to possible professional risks.

**The second research** was conducted in a design process of a virtual reality environment for training in the aeronautics industry. Technical tools have often been designed in a technical centered design approach and some are still design in this way. Ergonomics showed the limits of this kind of design process that not integrated user and situation of use as some main contributors of the design process. To deal with this, ergonomics proposed an alternative approach of design centred on user and, more recently "user experience" (Sauer et al., 2009). In the field of occupational training, these questions are meaningfully more complex: the aim is not only to analyze the existing work situation (that is the training target) but also, in training situation in order to identify and understand the needs of trainers and trainees (Boccara et al., 2015). We will present how this holistic

approach so-called “analyze of works” in production and training situations renew design process.

These approaches and their benefits for activity analysis in training design and providing will be developed (in each domain and also in the education sector) and discussed in the final version.

## [3410] Innovation throughout negotiation

Samuel Codegoni

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Innovation is quite difficult to reach in traditional contexts: that's why most of the Italian companies are so far from thinking to real innovation and have to be driven and accompanied into the process.

The innovation process is so easy (do something new and different) to impact on traditional company in a complex way, and it has to be constantly explained, clarified and negotiated with the customer itself.

Drop the Innovation process from above means scare and disorientate the company. Driving the company forward the innovation process throughout a correct reiterative activity, which is constantly explained and negotiate, means involve, engage and earn the trust to accelerate the process.

The economic and managerial sustainability of the innovation project is realized by calibrating the process with the various actors of the same.

The continuous exchange and the consequent continuous redefinition both of the work perimeter and of the expectations is the real potential act that allows the customer to follow the path, understanding correctly the project steps.

The nodal role of the negotiator for managing what we called "iperproject" passes through a great knowledge of the issues, a strong relational competences and a very solid methodological base.

These abilities (that can be found in one or more persons involved in the project) allow the actors of the change to move in all directions of the process through shifts, switches or jumps in the dark: the unexpected becomes a constant source of enrichment, and moreover the courage to effort the change grows up step by step.

Moreover, the negotiator can be helped by an external observer, who remains out from the project to provide constantly stimulation "out of the box" and revises the process giving an aseptic description of what's going on under a total different perspective.

Both negotiator and observer need to find yet the correct touch points between their reflections and the necessity of the company staff developing the innovative process, and they must always be focused on the final output.

The advantage of a correct project management is that on one hand, the negotiation is directed towards the structure of the process, so as to intercept the opportunities that the process itself

offers; on the other hand, the negotiation can be applied to the relationship between the internal company actors, to provide them the correct tools (temporary or permanent) necessary to develop the process giving the right contribution to it.

So the company can freely choose if persecute alone the change (thanks to the underlined process), or delegate it completely, but knowing how to manage it.

## [3222] Modular motor control in trans-femoral amputees' gait

Simone Ranaldi<sup>1</sup>; Cristiano De Marchis<sup>1</sup>; Martina Rinaldi<sup>1</sup>; Tiwana Varrecchia<sup>1</sup>; Alberto Ravanolo<sup>2</sup>; Francesco Draicchio<sup>2</sup>; Silvia Conforto<sup>1</sup>

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### Modular motor control in trans-femoral amputees' gait

**Simone Ranaldi<sup>1</sup>, Cristiano De Marchis<sup>1</sup>, Martina Rinaldi<sup>1</sup>, Tiwana Varrecchia<sup>1</sup>, Alberto Ravanolo<sup>2</sup>, Francesco Draicchio<sup>2</sup>, Silvia Conforto<sup>1</sup>**

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### INTRODUCTION

Muscular activity during walking is produced by the activation of a small set of motor modules that are called muscle synergies [1]. The latter can be analysed in terms of both composition and time activation profiles so supporting the characterization of pathological gait. During the rehabilitation process, trans-femoral amputees (TFA) adapt their walking pattern to their new physical conditions giving raise to some modifications of muscle activity especially during the swing phase of the prosthetic limb [2]. The present study has been carried on in a project funded by the National Institute for Insurance against Accidents at Work (INAIL) whose general aim is to analyze the modular motor control in TFA's gait during functional recovery.

### METHODS

8 healthy subjects ( $58.5 \pm 12$  years old) and 16 trans-femoral amputees ( $52.5 \pm 15$  years old) participated in the study. sEMG data were recorded from 12 muscles of the sound limb. Kinematic data was recorded with a stereophotogrammetric system and was used for the segmentation of stance and swing phases. Markers were placed over prominent bony landmarks on the skin according to Davis's [3] protocol. The experiment consisted of 12 repetitions of walking along a 6m walkway. Muscle synergies were extracted by means of a non-negative matrix factorization algorithm applied on the matrix containing the envelopes of the sEMG signal, as to obtain synergy vectors  $W$  and activation profiles  $H$ .

### RESULTS

More than 90% of the variability in muscle activation for each subject is accounted by four motor modules. The analysis of the four mean synergy vectors  $W$  – population average – has outlined similarity between the two populations (average normalized scalar product = 0.8). The observation of the four  $H$  profiles evidenced significant differences in shape between populations (especially for module 1 and 2), and the amputees' profiles showed a significant delay of the activation timing.

**Fig 1.**  $W$  and  $H$ , in arbitrary units.  $H$  are in grey for controls and in blue for TFA. The mean TFA profiles are shown in red. The green line outlines the toe off.

## **DISCUSSION and CONCLUSIONS**

The similarity of the motor modules between TFA and controls outlines the sharing of the same set of synergies. The differences evidenced in the H profiles can be interpreted as: i) for the first module as a stabilization mechanism of the ankle during the swing phase of the prosthetic leg, ii) for the second module as the attempt of compensating the propulsion force decrease during the swing of the prosthetic leg by increasing the hip extension moment.

Further investigations are being carried on in order to assess how the type of prosthesis and the time elapsed the first prosthesis implant could influence the results.

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## [2796] Shoulder motor patterns, fatigability and biomechanical leeway: sex/gender differences

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**Human Factors and Ergonomics Domains:** Gender and Work

**Productive sectors and services:** Others

**Presentation title:** Shoulder motor patterns, fatigability and biomechanical leeway: sex/gender differences (for Gender and Work Symposium)

**Introduction:** Studies show that twice as many women suffer from work-related musculoskeletal disorders (MSDs) in their neck/shoulder area as do men. Various reasons have been proposed to at least partly explain this observation, ranging from organisational, psychosocial and physiological factors. We have undertaken a series of experimental studies to compare the neurophysiological patterns displayed by men and women performing work-like repetitive arm tasks. The presentation will focus on a recent set of studies from our lab comparing posture and movement adaptations, and perceived exertion, pain perception and pain verbalization of men and women performing a repetitive manual work-like task until fatigue.

**Methods:** Forty men and forty-one women performed work-like repetitive upper limb tasks, while maintaining their entire arm elevated at shoulder height, until reaching a perceived level exertion of 8/10. Trunk, shoulder and elbow joint angles, neck/shoulder electromyography and ratings of perceived exertion (RPE) were measured every minute that the task was performed. Before and after the task, we measured neck/shoulder electromyography (EMG) and Pressure Pain Thresholds (PPT) and administered the McGill Pain Questionnaire (MPQ) and Pain Catastrophizing Scale (PCS) to better understand how men and women verbally described their sensation of, and attitudes towards, pain.

**Results:** Men ( $7.4 \pm 3.2$  minutes) and women ( $8.3 \pm 4.5$  minutes) performed the experimental task for the same duration. Although average shoulder elevation position decreased in both men and women, this decrease was greater in men (Standardized response mean [SRM]: -1.63) than in women (SRM: -1.44) with fatigue. However, women utilized their trunk more ( $10.9 \pm 5.0^\circ$ ) than men ( $8.9 \pm 4.4^\circ$ ) in contributing to the task. There was a significant sex difference ( $F(1,26) = 5.72$ ,  $p < 0.05$ ) in shoulder pain threshold, with men reporting higher PPT than women. There were significant positive correlations between RPE and both upper trapezius [ $r_s = 0.48$ ,  $p = 0.000$ ] and

anterior deltoid EMG [ $r_s = 0.37$ ,  $p = 0.001$ ] in men, whereas women showed a weaker relationship between RPE and upper trapezius EMG [ $r_s = 0.22$ ,  $p = 0.034$ ], and no relationship between RPE and anterior deltoid EMG [ $r_s = 0.11$ ,  $p = 0.293$ ]. Finally, endurance was correlated to changes in PPT in men, whereas it was correlated to pain catastrophizing in women.

**Conclusion:** Our results suggest that despite many similarities between men and women's response to muscle fatigue induced by repetitive work-like tasks, there seem to be some subtle sex/gender differences in their fatigue adaptation mechanisms. These mechanisms seem to be based on physiological signals in men, whereas they may be based more on complex, whole-body and feedback interpretation mechanisms in women. However, more studies, from fundamental and applied, ecological natures, need to be performed to shed more light into sex/gender-specific MSD mechanisms.

## **[3269] Professional Ergonomics Education in Argentina**

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Title : Professional Ergonomics Education in Argentina

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Key words: education, standards and education quality, Argentina

Argentina's first postgraduate degree in Ergonomics started in 2006 at Universidad Tecnológica Nacional in Buenos Aires. It was designed and directed by Gabriela Cuenca taking into account IEA's core competencies and CREE's guidelines. From 2011 to 2014 Michelle Aslanides relayed her and added a supervised intervention methodology training. Since 2015 it is coordinated by Lucie Nouviale and Martín Rodríguez. Until today UTN has educated almost 100 ergonomists.

The postgraduate program developed an activity ergonomics approach that changed the point of view of the students that came from different backgrounds. Today they are very good ergonomists but they are also better professionals in their previous field (medicine, psychology, engineering, physiotherapy, etc.) because they have integrated this new point of view about work.

This program is the only one functioning in the country. This is the consequence of an internal policy that has established not to open new master degrees in other parts of the country, as it could fragilize the one in Buenos Aires. This turns the amount of educated professionals very low, which makes our profession weaker and less recognized than others like occupational safety and health professionals.

Ergonomics as science is recognized, but professionals aren't recognized yet: medical and safety and health professionals have decided to use the term "ergonomics" in our Safety and Health legislation. We have since 2003 two legislations, 295/03 and 886/15 not validated by the majority of professional ergonomists that limit our professional scope and, what's worse, leave us out of the market if we are not safety and health or medical domain specialists. On the other hand, this legislation gives all the power to act in the name of ergonomics to safety and health and medicine specialist, basing their intervention methods in simple checklists that only apply to certain working situations. The legislation only states that the intervention should be finished and completed by a professional "with knowledge in ergonomics" not specifying which knowledge they refer to. This is a fertile terrain to all kind of speculations in terms of education trainings, that offer all "ergonomist

expertise” some of them in 20 hours. Nevertheless, the legislation opens new opportunities for professional ergonomists, even if requests based on this legal logic have to be redefined at each intervention.

Therefore, IEA referentials as core competencies and certification standards are important to help professionals in these contexts to establish the requirements for a professional education and practice. Also the support from IEA when a master degree is opened should exist as a way of recognition. IEA also should promote access to international IEA triennial congresses for members of our federated societies who cannot afford the high prices.

More information about the program

[http://posgrado.frba.utn.edu.ar/carreras/esp\\_ergono.php](http://posgrado.frba.utn.edu.ar/carreras/esp_ergono.php)

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## **[3268] Reflections on the experience as coordinators of specialization programs in ergonomics in Brazil: The case of USP, UFMG and UFRJ courses**

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### **Reflections on the experience as coordinators of specialization programs in ergonomics in Brazil: The case of USP, UFMG and UFRJ courses**

#### **ABSTRACT**

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This paper focuses on our experience in the coordination of specialization programs in ergonomics, aimed at students whose perspective is the acquisition of knowledge and experience to act as professionals in this area. The content is related to the experience acquired over approximately 15 years in the coordination of courses at engineering schools of the University of São Paulo, at the Federal University of Minas Gerais and at the Federal University of Rio de Janeiro, Brazil.

The professional challenges for these students are very significant because, once they have obtained a degree in ergonomics, they have to present themselves to society as subjects capable of developing activities in the context of work analysis and its transformation. Finally, our proposal as teachers is related especially to afford conditions to students as learning enablers. The fact that those students will work directly involved with people's work, mainly related to health and the possibilities of professional development in different categories of workers, carries a huge responsibility.

For us this experience shows that it was no longer a question of acting as teacher in isolated disciplines in a engineering program, even if, while important in the learning process of undergraduate and postgraduate engineering students, may not be central to engineering activities. In the case of the specialization programs, all disciplines are fundamental to the learning process of future professionals in ergonomics and they are all correlated.

Thus, experience has helped us to understand the role of teachers is greatly modulated by demands of society which are expressed, in part by the students, and which are already part of our own requirements, modulated by our performance as specialists, researchers and teachers in the field of ergonomics and, more broadly, in the sciences of work.

The work as teachers engaged in providing meaningful learning for future ergonomists has great challenges, since the people's work is not considered as central in the universe of production, even though ergonomics is a legal requirement for companies in Brazil. This also influenced our performance, since the struggle to keep work as central to production, given that, in the last three decades, there was a strong movement claiming that work should be considered as something less relevant in productive processes, that is, the centrality of work would not be in the agenda in companies. Otherwise, reflecting about the division of work among societies and countries around the world we should reflect about what kind of demands will be prevalent in ergonomics in a country like Brazil.

## **[607] Revealing the weakening processes of part-time teachers' activity by cross-methods: a lever to improve their working conditions**

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This communication seeks to bring forward elements on the working conditions of part time teachers (often women) of the secondary level (middle school and high school) in France and to reveal some discriminatory practices toward them.

On the basis of various investigation methods – interviews (20) - study of timetables - questionnaires on their experience at work (106) - we will highlight their difficulties.

We will show that, contrary to the reasonable expectations in terms of improvement of their working conditions, they often see their working conditions deteriorate, their institutional recognition weaken and are the target of invisible discriminations processes. Indeed, choosing to work part-time is often considered as a form of professional disengagement. On the principle of "give and take", the principal (or head teacher) wishes to favour full-time teachers, without taking into account family or health issues which lead to the choice to reduce the working hours.

It will highlight that part time has an impact on their professional activity (timetables, involvement in related activities, classes allocation, assessment by management and administration, pressure to return full-time) but also on their life outside of work. It contributes to a feeling of injustice and discrimination which can result in conflicts with their management.

To work part-time also places them in a complex position towards their colleagues, it pushes them to change their wishes of classes' affectation at the end of the year, developing a form of guilt because of the extra hours they impose to these colleagues. As a result, part-time work not only impacts working hours, but is also crucial for division of labour within the team. It becomes a collective topic where everyone's professional and personal stakes can generate anxiety.

From an organizational point of view, part-time work emphasizes the pre-existing issues related to the teachers' shortage in schools, increasing the number of extra hours that the head teacher has to convince full time teachers to accept. As a consequence, part time teachers can generate tensions within the disciplinary teams but also at the management level. It's in this context that we have identified certain harassment behaviours by head teachers toward the part-time teachers.

Far from being a satisfactory solution which would systematically improve overall work/life balance, part time work can ultimately make these teachers more fragile.

We will show how making these hidden mechanisms visible in one of the high school studied, enabled people to discuss these practices and managed to reduce the inequalities of treatment which plague part-time teachers.



## [2783] Observation methods in the context of interactive research

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## Observation methods in the context of interactive research

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Interactive research is a research approach that has many similarities with action research, but also differences. One difference is that the responsibilities of the researcher do not include taking action in the organisation (Ellström et al., 1999). Also, there is a stronger focus on research for creation of generalized knowledge, rather than on local development (Svensson et al., 2002). As in action research, there is a strong emphasis on participation and partnership with the practitioner organisation, but the research may be critical to the organization (Aagard Nielsen, 2006). The interactive research approach can be regarded as an umbrella under which traditional research methods are applied. This means that methods such as interviews, focus groups, questionnaires, ratings, direct measurements, document studies, activity analysis and observations are common.

The aim of this paper is to give a brief overview of interactive research and procedures that are used. In particular, the aim is to focus on observation methods.

The methodological procedure in an interactive research project is that the researchers and practitioners have thorough initial discussions in order to define the aim and overall design of the collaboration. In the next stage, the researchers collect data with their methods, make an initial analysis and feed the results into a joint analysis seminar with the practitioners and researchers. This analysis seminar is a corner stone in the interactive research approach, and the joint learning between researchers and practitioners take place here.

One of the commonly used methods is observation, which can be performed also by the practitioners. Observation may be the first method applied, which leads to deeper investigations with other methods, in order to validate or challenge the observation results. The reverse is also possible, that other input results lead to an observation study. The frameworks used include activity analysis and Humans - Technology - Organization. Examples from previous studies have supported that observation of fork lift truck drivers work activities, postures and movements in combination with other methods could identify critical tasks. The opposite has occurred in other studies where the cause of a statistical risk was identified through observation. More examples of interactive research projects support that observation methods are important for several reasons. They often confirm what people already have an intuitive feeling of. Observation methods can give qualitative as well as quantitative results. They serve as initiating new issues that are investigated further through other methods usage or they serve as confirming the results from other methods. Further, for some aspects, reliability is not very high. One example is observation of postures and movements, and in particular wrist postures and angular velocity. To conclude, observation methods are inherently interwoven in interactive research.

These are related to methods such as RAMP, HTO or activity analysis  
*Keywords:*

## [1953] Implementation of a gender approach to chemical hazards in vineyards

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We base our research on the transmission of knowledge created at work on the body's experience of work or on the effects of work on the body. We seek to develop from scientifically developed materials and tools (scientific documentations like INRS, MSDS, physicochemical properties of molecules, traces of exposures, video, measurements ....) concrete resources on which workers can rely to improve the maintenance of their health and work performance in the face of unclear, diffuse and delayed chemical hazards.

We are currently conducting a participatory action research in ergonomics on the detection of chemical hazards in viticultural environment. We have hypothesized that to enhance the "in situ" development of "syncretic" objects would improve field capacity to detect and prevent situations which influence the exposure. We propose a training-action intervention to detect "invisible" exposure situations, an intervention that encourages men and women who conduct an activity in a contaminated environment to develop and transmit their preventive know-how.

In this approach, workers handling products that may be hazardous to human health are considered as experts on their exposure and its prevention, at least in the same way as authorities and scientists working on the subject. Noting that the relatives of these workers (spouses, parents, children, others on the farm) also develop sensory preventive know-how we worked to establish a method that takes their expertise into account and that uses it as a lever to transform exposures.

We examine chemical hazards exposure as a consequence of the sexual division of labour. We characterize activities involving direct and indirect exposure, considering both activities inherent in wine production and also the ancillary activities, often carried out by women, where hazards seems less visible. We examine how women are involved in the conduct of "dangerous activities" focusing on the know-how of the men and women exposed to a contaminated environment. Beyond gender, the fact that a worker's life companion may be outside the agriculture/labour sphere will also be taken into account. Our methods involve characterizing exposure situations and reflecting on their transformation. We use an approach combining empirical and theoretical knowledge. From the study of sensory know-how to the study of co-construction of protocols for chemical hazards detection. We will describe this methodology as well as gendered representations of chemical risks in a wine growing environment transcending the usual border between the professional and private spheres.

## [1519] Ergonomics communication among radiologists/hospitals

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In the last years, the possibility of transmitting radiological exams at a distance (that is called tele-radiology) has been increased more and more, and actually is one of the most developed fields in tele-radiology.

Initially, there were only transmission systems with a “slow video function”, in which analogical images were filmed, and after sent at a distance through telephone network systems.

Currently, the radiology evolution towards digital technology, the advent of RIS-PACS systems (Radiology Information System – Picture Archiving Communication System) and the development of optical fibre transmission networks have permitted to obtain high quality images and very short sending time.

However, this type of work settlement involves some difficulties and risks, which may be solved or avoided through a correct ergonomic valuation.

First of all, it is necessary to preliminary consider all the aspects linked with privacy, which may be breached if the transmission system results unsafe.

Secondly, the radiologist workload must be considered: he should be able to value with adequate time both the exams which are carried out in the hospital where he works, and the ones which are tele-transmitted from others hospitals.

In any event, for all tele-transmitted exams, the possibility to have a clinic referent in loco is essential.

All those aspects were correctly defined in a relevant reference document, called “Guidelines for the teleradiology quality assurance” published in Reports 10/44 from the Italian ISTISAN (Superior Institute of Healthcare) in 2010.

Further, there are some purely ergonomic aspects linked with the technological characteristics of the work-stations, of their structural realization (monitor type, dimensions and characteristics, distance of the operator, option of interface other digital instruments), and the conformation of the workstation where the physician is allocated.

In addition to this, there must be considered all aspects related to communication with the technician of medical radiology department and the clinical referent (generally a radiologist) at the hospital from where the images are sent. That communication process must be fast and fluid; indeed, a delay in the exchange of information could report deep consequences for the patient’s health.

It will therefore be appropriate to dispose ergonomic solutions which will consent to the physician who receives the images to discuss correctly and directly with the referent of

another hospital. This without losing the contact with the devices for the receipt and images' visualization.

Another aspect to be considered is the immediate environment: the conditions of the working rooms (brightness, noise, easy (or not) access, proximity with sources of disturbance, as could be the emergency room, high level activity rooms, etc.) may influence a lot the radiologist's performance.

Finally, adequate ergonomic solutions may consent a right teleradiology development, which bring benefits for both patients and operators.

## [3111] Occupational health in radiologists

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Radiology is a medical practice in use from more than a century. During this period deep technological developments, including e.g. the new interventional and nuclear medicine procedures, the use of Non Ionizing Radiations (NIR) and other, have revolutionized this practice. In parallel, also the scenario of the occupational risk related to the practice of radiology is largely changed: in the following part we approach some aspects of major current relevance. The most known risk factor, Ionizing Radiations (IR) exposure, is still a significant problem; in fact, even if currently exposure levels are generally low, in some activities, as in interventional medicine, significant exposures can occur. In medical radiation workers exposed to the current levels of radiation doses, to date there is no clear evidence of an increased cancer risk, e.g. of leukemia, even if some concerns still exist e.g. on female breast cancer. Furthermore, an important problem are recent data showing a much lower threshold for IR induced related cataract, inducing the International Commission on Radiological Protection (ICRP) to recommend a relevant lowering of occupational eye exposure limit: from 150 to 20 mSv/year. Curiously, some recent results suggest an inadequate awareness of the occupational IR risk in radiologists. A more recent physical risk is the exposure to NIR, related to the introduction of Magnetic Resonance Imaging (MRI). Different NIR are generated during MRI procedures, but the main problem is static magnetic field (SMF): especially with 3 Tesla scanners the exposure is highly enough to possibly induce in operators subjective symptoms as vertigo, nausea, metallic taste or magnetophosphenes; this problem is likely to increase with the introduction of the new 7 Tesla scanners. Another occupational risk in radiologists is blood-borne pathogens (BBPs) exposure, even if few studies recently evaluated this problem from the epidemiological point of view. At higher risk are personnel such as interventional radiologists: some recent data indicate that accidental needlestick and sharp injuries are ubiquitous and frequent among interventional radiologists: on average 1 needlestick injury for every 5 years of practice in a recent study; most often injuries not reported. Another emerging problem in radiologists is the high prevalence of musculo-skeletal disorders, especially neck and back pain. Among interventional radiologists the most likely cause is a combination of the need of wearing heavy protective garments, together with long standing and long maintained awkward positions. Similar results were recently observed also in radiologists; in this case the main risk factor was considered the sedentary behavior of radiologists, together with low activity during work, and the long time spent in sitting position. For all the above-mentioned problems measures for an effective prevention are generally available, but a problem here is that radiologists seem generally to undervalue the occupational risk.

## **[3751] Contribution of the SMR (Smart Mature Resilience) project towards the European Resilience Management Guideline**

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### **Contribution of the SMR (Smart Mature Resilience) project towards the European Resilience Management Guideline**

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#### **Background**

The project H2020 SMR – Smart Mature Resilience, along with four other H2020 projects on resilience funded by the topic DRS-7-2014: Crisis management topic 7: Crises and disaster resilience – operationalizing resilience concepts, is a contributor to the set-up of the European Resilience Management Guidelines.

#### **Consortium**

The SMR consortium consists of four universities (Agder, Norway; Linköping, Sweden; Strathclyde, UK; Tecun, Spain), seven cities (Bristol, Glasgow, Kristiansand, Riga, Rome, San Sebastian, and Vejle), the German Institute for Standardization– DIN, and ICLEI – Local Governments for Sustainability. The fact that four of the cities (Bristol, Glasgow, Rome and Vejle) belong also to the 100 Resilient Cities initiative, by the Rockefeller Foundation, created synergy and added value to SMR.

#### **Development of tools**

One of the outstanding results of SMR is the development of specific tools for the assessment and enhancement of Urban Resilience. The tools have been tested and validated in the cities participating in the project.

The tools developed during the project are:

- The Risk Systemicity Questionnaire (RSQ) is an advanced participatory instrument aimed at promoting discussion and raise awareness on risks and resilience challenges cities are facing.
- The Maturity Model (MM) is a framework model adapt to define, on the basis of measurable and qualitative parameters, the resilience level of a city, along with policies to advance the resilience level.
- The City Resilience Dynamics Model is a training tool that helps cities explore different strategies regarding the implementation of resilience policies, simulate the results of each strategy and learn about the resilience building process.
- The Resilience Building Policies tool complements the SMR Maturity Model, the Risk Systemicity Questionnaire and the City Resilience Dynamics tool by providing a collection of case studies as reference to cities for further information.

- The SMR Resilience Information Portal provides a collaborative environment in order to facilitate awareness and engagement among key partners in resilience building.

In addition, work was carried out in standardization of resilience concepts, to formally define the terms and indicators to be utilized in this new science. Resilience – and urban resilience, in particular – is a sector nowadays under development, and definition of its standards is an unquestionable need.

**Project Website:** [http:// http://smr-project.eu/home/](http://smr-project.eu/home/)

#### **ACKNOWLEDGEMENTS**

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## **[2797] Female working refugee children: a triple burden of vulnerability**

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**Submission to the International Ergonomics Congress 2018, Florence, Italy**

**Title: Female working refugee children: a triple burden of vulnerability**

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**ABSTRACT:**

This study is based on fieldwork done with children refugees aged between 8 and 18 who are living in Lebanon. While males are traditionally the bread winners in the family, the dire economic situation of refugees pushes all family members – children and adults – into doing whatever they can to provide some income. We focus here on the added vulnerability of female refugee children who work in the small local industries that thrive on cheap labor supply coming from refugee camps. These children fall under a triple burden of vulnerability resulting from their position as refugees, as children, and as females. The fact that they work and provide income does not absolve them from their obligations toward male family members and the household as a whole. Their responsibilities span the work and home environment. Being females, they have a duty to care for the well-being of their family members and to take care of house chores typically considered the domain of females, like cooking and cleaning. They also need to look out for the younger members of their household which might include siblings or members of the extended family, like cousins or nephews. Often times, girls aged 10-12 years are seen sorting vegetables while at their side a 3-year-old / toddler is playing or sleeping. In addition to taking care of the family's needs and demands, they have to work in an environment that is often hostile and that lacks even the most minimal measures of protection.

Refugees are mostly engaged to do menial, labor-intensive tasks. While males generally work on construction sites, in car workshops, and in agricultural fields, females are typically employed in sweet shops, or work on picking vegetables and arranging them to be sold, collecting plastic bags and iron rods for sale, and collecting and selling goods. As young females, these children are at any time subject to harassment and abuse. Their dire economic situation does not allow them to denounce such abuse or fight it; if they do, they might lose their source of income.

The data gathered during the course of this study will be used to answer the following questions: How do these children cope with the pressure of meeting work demands inside and outside their household? What are the health-related consequences of leading such a lifestyle; both on the physical and psychological levels? How can a sex/gender-sensitive ergonomics intervention take into consideration the complexities of the context in which these children are living and working? For example, social and cultural expectations and norms with regards to females and their role in the family. In addition to the study results, the paper will focus on the survey methods used for data collection underway.

## **Human Factors and Ergonomics Domains: Gender and Work**

### **Productive sectors and services: Agriculture and**

## **[2287] The development of an adaptive device for children with a hand impairment.**

Erik Haring<sup>1</sup>; Kristof Vaes<sup>1</sup>; Steven Truijen<sup>1</sup>; Maarten Van Nuffel<sup>2</sup>; Lotte Quirijnen<sup>1</sup>; Stijn Verwulgen<sup>1</sup>

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Children with an upper limb reduction deficiency (ULRD) often have trouble performing activities of daily living (ADL) but tend to compensate the loss of function by using the remaining limb in a different manner for support

For some specific, mostly bimanual, activities, so-called terminal devices are proven to be useful in combination with the prosthesis [5][3]. However these devices are expensive, and in some cases they require a new socket in order to be used [5]. Recent organisations like enablingthefuture.org [6] offer opensource developed and low-cost devices. Most of these adaptive devices (AD) are body-powered mechanical 3d printed hands suited for children with a ULRD of the hand. A study of Vasluiian [7] showed that children in the Netherlands are commonly provided with some sort of AD to support them with the ADL. The AD's in the study were mostly made by professionals (79%) with the remainder to be home-made devices (16%) [7]. The study excluded children with mild symbrachydactyly (< 4 missing fingers) as they are considered a low-degree of functional impairment.

We hypothesize that children with a mild to severe form of symbrachydactyly still can benefit from an adaptive device to support them with certain ADL. Searching the literature, we have only found two examples of AD [6][7], no AD exist that consistently supports children with symbrachydactyly. In this study, we suggest an AD (Figure 1) that is evaluated on its beneficiary effect, stigma and appeal for children with symbrachydactyly with a functioning thumb.

In this study, several children (and/or adults if necessary) with symbrachydactyly are fitted with a prototype of the concept AD and the functionality of the device is tested with the Southampton Hand Assessment Procedure (SHAP). This test is designed to measure the functional range of the hand [8] in clinical practices for testing prosthetics and assessing the impact of hand impairments on the functional range [8][9][10]. The test consists of multiple geometrical objects with different textures and weights to be move from one place to another and fourteen activities representing ADL. Because of the size of the objects used with the current version of the SHAP test, the test is only suited for adult participants. We use an adaption of the SHAP test i called SHAP-c, which is suitable for children [11],.

With the SHAP-c test we aim to obtain information about the functionality of the suggested AD used by children with symbrachydactyly. Aside functional evaluation of the AD with the SHAP-c test qualitative research information is gathered to evaluate the appeal and stigma of the AD.



Figure 1. Child using a prototype of the concept AD

## **[3264] A multi-disciplinary approach to Ergonomics Education: lessons learned from the UCSF/UCB Ergonomics Research & Graduate Training Program**

Carisa Harris<sup>1</sup>; David Rempel<sup>1</sup>

<sup>1</sup>*University of California, Berkeley, USA*

### **A multi-disciplinary approach to Ergonomics Education: lessons learned from the UCSF/UCB Ergonomics Research & Graduate Training Program**

Carisa Harris, PhD, CPE & David Rempel, MD, MPH

The University of California at San Francisco and Berkeley Ergonomics Research & Graduate Training Program (UC Ergo Program) was established in 1991 by Dr. David Rempel in the Center for Occupational & Environmental Health (COEH) through an initiative funded by the State of California to improve the protection of workers and communities from workplace and environmental health hazards through teaching, research and service. Work-related musculoskeletal disorders, such as low back pain, tendonitis, and shoulder injuries are the most frequent and costly injuries in California. The losses associated with lost time injuries and funding from the state through COEH has helped to create and sustain our program. During the past 27 years, the UC Ergo Program has supported a steady stream of students, community service and scholarship through a mixture of funding of sources. Graduates (MS & PhD) of the program are now professors at other universities and direct ergonomics research and safety programs at most large companies and agencies in California.

Interdisciplinary and intercampus bridges have been key to providing a robust educational and research training program in a cost-efficient manner. The program provides ergonomics training to Occupational Health Nursing and Medical Residency Program, Industrial Hygiene, Public Health and Engineering Graduate Students. The collaboration of these future practitioners creates an inter-professional educational experience that is unique. In addition to classroom lectures in biostatistics, epidemiology, occupational biomechanics and industrial design, students are required to complete field projects, summer internships and a research project that match their interests and degree. Additionally, the program provides continuing education opportunities to professionals that include in-person classes, hands-on workshops and an upcoming launch of online classes to prepare practitioners for national certification by the BCPE.

The challenge of creating customized and interdisciplinary educational pathways for students of various disciplines is outweighed by the benefit of providing future ergonomic practitioners,

engineers, researchers and caregivers with an in-depth collaborative training experience that prepares them for their eventual experience in industry and academia. IEAs affiliation with various societies and organizations allows them to provide excellent guidance on core learning outcomes and play a key role in curricular planning. With the addition of online education, the IEA will be a critical partner in ensuring that students and practitioners around the world, particularly in low and middle-income countries, are aware of the educational opportunities and scholarships offered. IEA can play a critical role by highlighting educational opportunities and finding additional sources of scholarship to support the training of future leaders in ergonomics internationally. Lack of awareness and lack of financial support from government and industry are the two biggest threats facing our program. Internally, our biggest challenge is increasing awareness about our program and the viable career options that HF&E offers.

**[838] Taking account of gender differences when designing interventions in occupational health? Lessons from a study of the “Healthy Enterprise” standard in Québec**

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**Presenter :** Hélène Sultan-Taïeb

**Human Factors and Ergonomics Domains:** Gender and Work

**Productive sectors and services:** Others

**Title:**

« Taking account of gender differences when designing interventions in occupational health? Lessons from a study of the “Healthy Enterprise” standard in Québec »

**Abstract:**

The literature shows substantial differences in occupational exposures between men and women, both between and within occupations, but remains very sparse on whether interventions are tailored to gender differences in the workplace. Our objective was to determine whether gender differences were taken into account when designing prevention interventions in seven

organizations. This objective was broken down into two research questions: (Q1) Given the fact that occupational exposures tend to be different between men and women within the same team in the same organization, the question was whether activities were targeted differently toward men and women when these two groups were exposed to different risks; (Q2) Men and women may have different

interests, capabilities, and availabilities to participate in preventive activities, therefore was the choice of activities intended to be more adapted to men or to women in order to encourage employees' participation in activities.

This study is part of a project on the evaluation of interventions implemented in the framework of the "Healthy Enterprise" standard in Quebec organizations. The majority of activities were healthy life habits interventions. Three sets of quantitative and qualitative data were collected in seven organizations. Qualitative data were analyzed through thematic analysis a posteriori for Q1. For Q2, we performed an inductive thematic analysis for the nature of the activities, and a deductive classification

process was used with the areas clusters of the "Healthy Enterprise" standard. Qualitative and quantitative (proportion of men and women within each organization) data were triangulated.

Our results show that in the process of designing and implementing activities, the main objective was to reach a maximum number of workers. The health and risk pre-intervention diagnosis was an important criterion for the choice of activities to be implemented. However, this preliminary diagnosis did not describe the situation of men and women separately. Activities did not appear to be tailored to the needs of specific subgroups of employees, such as gender or age. A close analysis of the nature of activities did not allow us to identify activities as better adapted to women in the organization where 81 percent of workers were women or better adapted to men in the organization where 72 percent of workers were men. This study shows that in a context of a majority of healthy life habits activities, it is difficult to identify activities more adapted to men or women for methodological reasons, since there is no consensus in the literature on criteria for categorization of typical "masculine" or "feminine" activities. For practical implications, these results suggest that gender was not an important concern in the organizational health and safety interventions under study, whereas the scientific literature insists on the need to take into account differences between genders.

Word count: 449

## [2642] Visual Ergonomics for radiology

Hillevi Hemphälä<sup>1</sup>

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When looking at radiology images, such as x-ray pictures and ultrasonography, it is essential that the lighting does not interfere with the ability to clearly see the images.

If the illuminance is too high the contrast on the screen will be affected and the pictures might be interpreted incorrectly, so this is a matter of patient safety. Unfortunately, the low levels of illuminance affect the personnel's alertness levels and can also cause eyestrain and tired eyes.

The computer screens consist often of a highly glossy surface that causes reflexes on the screen from luminaires in the room. If the screens instead had a matt surface these reflexes might be reduced.

In one smaller study with medical doctors analysing x-ray pictures it was found that the levels of illuminance was as low as 5-9 lux. This caused major problems for the doctors with eyestrain and headache. The doctors participating in the study received bifocal lenses in their spectacles, specially designed for the screen distance they used. Some of the doctors experienced less eyestrain but still experienced a lower alertness.

To increase alertness a higher level of illuminance is needed. Preferably dynamic lighting that can improve the circadian rhythm. The melatonin levels can be affected by too little light and disturb our circadian rhythm.

In another study regarding lighting recommendations for minimally invasive surgery new lighting recommendations were formulated. During minimally invasive surgery the operator will perform surgery while looking at a computer screen. The lighting recommendations for this was previously to dim the lighting in the room so that there were 50 lx over the anaesthetic area. In this study, consisting of both a lab study and a field study, it was concluded that the general lighting in the entire room could be increased to about 100 lx (white light with 3500-4000 K) without affecting the visibility on the screen. This is a huge improvement for the personnel in the operating theatres and it improved their ability to perform their work tasks.

Coloured lighting (red light behind the operator and green light behind the screen) is also tested for minimally invasive surgery and showed the same result as the increased white light. But the anaesthetic personnel rated the coloured lighting as better, and that the visibility of their work tasks increased.

It seems like that coloured lighting (red light at 100 lx) will increase the visibility on the screen while performing ultrasonography and looking at x-ray pictures. But more studies need to be performed in order to draw any conclusions regarding this.

Finally we can conclude that the illuminance for radiology can probably be increased to increase wellbeing among the personnel and improve patient safety.



## **[1672] Ergonomic challenges and interventions in radiology digital imaging**

Sven Hoffmann<sup>1,2</sup>

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The introduction of digital systems in healthcare has brought numerous advantages, e.g. reduced radiation exposure to patients and staff, availability and accessibility of patient information, as well as computer-aided diagnostics. However, those advantages come alongside with ergonomic challenges and health hazards. By cross-sectional imaging becoming wide-spread available as well as cheaper, the number of classical and cross-sectional images per patient has increased dramatically. New technologies e.g. 4d dw-MRI imaging or the combination and fusion of radiology imaging systems e.g. PET/CT requires the radiologist keeps up with e.g. additional workload, increased density of information per image, as well as new insights into the physiology and pathology of patients. In the future, additional challenges may apply by further developments in augmented 4d-reality imaging, computer-aided automatized image diagnostics as well as developments in radiology telemedicine.

This presentations aims to present the current literature as well own research on clinical radiology workplaces. The change of film-based to soft-based image handling and image diagnostics will be addressed. Furthermore, current radiologist workplaces will be reviewed, identifying frequent health hazards and opportunities for adaptations and ergonomic interventions. Special attention shall be payed to the occupational environment, including physical and organisational factors, e.g. impact of light exposure and workplace lighting design on attentiveness, sleep quality and wellbeing at work.

The author will be thankful to discuss his propositions with the audience.

## **[3749] The Development and Application of a European Resilience Management Guideline in the RESILENS Project**

William Hynes<sup>1</sup>

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### **The Development and Application of a European Resilience Management Guideline in the RESILENS Project**

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#### **Background**

Critical infrastructure (CI) provides the essential functions and services that support European societal, economic and environmental systems. As both natural and man-made disaster and crises situations become more common place, the need to ensure the resilience of CI so that it is capable of withstanding, adapting and recovering from adverse events is paramount. Moving resilience from a conceptual understanding to applied, operational measures that integrate best practice from the related realm of risk management and vulnerability assessment is the focus of the RESILENS project. RESILENS (Realising European ReSILience for CriticAl INfraStructure) developed a European Resilience Management Guideline (ERMG) to support the practical application of resilience to all CI sectors. Accompanying the ERMG is a Resilience Management Matrix and Audit Toolkit which enables a resilience score to be attached to an individual CI, organisation (e.g. CI provider) and at different spatial scales (urban, regional, national and transboundary) which can then be iteratively used to direct users to resilience measures that will increase their benchmarked future score.

#### **Nature of the RESILENS Resilience Management Guidelines (ERMG)**

The ERMG and resilience management methods was tested and validated through stakeholder engagement, table-top exercises and three large-scale pilots (transport CI, electricity CI and water CI). The ERMG and accompanying resilience methods are hosted on an interactive web-based platform, the RESILENS Decision Support Platform (RES-DSP). The RES-DSP also hosts an e-learning hub that will provide further guidance and training on CI resilience. Overall, RESILENS aims to increase and optimize the uptake of resilience measures by CI providers and guardians, first responders, civil protection personnel and wider societal stakeholders of Member States and Associated Countries.

#### **ERMG development**

The first Draft ERMG was based on an integral master document composed of the following chapters: Introduction and instructions on how to use the document; Professional terminology; Generic chapters dealing with resilience management for CI: requirements; Specific chapters on resilience management by case sectors. E.g. power utilities, energy (Gas & Oil), transportation (surface transport, aviation, maritime), telecommunication, water and sewage; Finally instructions for the measurement, evaluation and audit of resilience of CI.

The ERMG provides **standardized terminology recommendations** within and across sectors and a **methodological approach to the development of an integration matrix**, derived and taken from risk assessment and resilience management across various CI sectors, rescuers and other end users. Key to success is that the final, validated and harmonised ERMG addresses the **needs and requirements of end-users (CI providers, rescuers and the wider society)**, and can be operationalised in a variety of sectors.

**Project Website:** <http://resilens.eu/>

## **ACKNOWLEDGEMENTS**

The development of the RESILENS guidelines is a collaboration between The University Of Warwick (UK); Fraunhofer Gesellschaft Zur Foerderung Der Angewandten Forschung E.V, Fraunhofer (Germany), TCD Ireland; M T R S 3 Solutions And Services LTD MTRS3 (Israel); Factor Social - Consultoria Em Psico - Sociologia E Ambiente Lda Factor Soc (Portugal); Skills For Justice (Enterprises) Limited Sfje (UK); Bundesanstalt Fuer Strassenwesen BAST (Germany); EDP Distribuicao Energia Sa Edp Distr. (Portugal); Eastern And Midland Regional Assembly EMRA (Ireland); Camara Municipal De Lisboa CML (Portugal); and Irish Water. The research leading to the results received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 653260. Opinions expressed in this publication reflect only the author's view. The European Commission is not liable for any use that may be made of the information contained in this paper.

## **[1660] Tele presence robots - a human substitute: preliminary findings.**

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Today's technologies and business requirements allow for, and even demand, distance management (Fisher & Fisher, 2001). One concern for distance managers is to ensure employee wellbeing so that distance employees can perform (Poulsen & Ipsen, 2017). Therefore, distance managers look for processes and technologies that can support the building of trust and create a sense of proximity across distances, which are two key elements of employee wellbeing (Fisher & Fisher, 2001; Poulsen & Ipsen, 2017). In distance work, the dialogue between distance workers and their manager is a core activity and primarily conducted via Skype, phone, Lync, email and if possible, telepresence technologies (Ipsen, Poulsen, & Nielsen, 2015). Telepresence technologies, specifically, also exist in mobile versions, termed mobile remote presence (MRP) technologies, where telepresence robots (TPRs) as the Double from Double Robotics is an example of this. TPRs require that two people interact through one robot - the person that controls the robot, which acts as the user of the Double, and the person that is exposed and interacts with the robot (the double) as part of his/her daily work practices. The interaction thus becomes two-way via the TPR. Consequently, TRPs can improve interaction across distances, but require different considerations for implementation and use as they involve human-robot interaction (HRI).

HRI can be studied from a robotics-centered or human/user-centered perspective. Despite increased attention to the use of robots in work processes, research has yet to uncover the dual/two-way interaction and application of TPRs in distance work and management. With this paper, we contribute to a clearer understanding of the application and interaction across TPRs. Our goal is to explore managers and employees' perspective and experiences with and use of TPRs.

The paper presents findings and draw conclusions building on a multiple explorative case study in companies during 2017. Data collection methods includes semi-structured interviews, feedback mechanism, on-site observations and notes. We focus the data collection and analysis on the interaction between distance employees and the TPRs with a three-fold purpose: (1) assess positive and negative user experiences, (2) determine in which situation TPRs are usable, and (3) highlight the personal feelings and emotions involved. To do so, we explore the use and adoption of the TPR technology building from Venkatesh and Davis' Technology Acceptance model (2000) TAM, which focuses on the user's acceptance of the technology to ease technology adoption and thereby performance. Particularly the newest version is used: the TAM3, evolution of TAM2 (Venkatesh, Davis, Smith, & Walton, n.d.), that embraces new determinants of perceived usefulness and perceived ease of use (Venkatesh & Bala, 2008).

Overall, we provide an insight to situations where distance managers can successfully apply the TPRs and propose a guideline for implementation.

## **[1057] The impact of heavy load carrying on musculoskeletal pain and disability among women in Shinyanga Region, Tanzania.**

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### **Background**

Heavy load carrying has been associated with musculoskeletal discomfort (MSD) and disability. However, there is a lack of research investigating this association in resource-constrained settings where heavy load carrying by women is common.

### **Methods**

We conducted an exploratory cross-sectional study amongst a population of women who carry loads as part of their activities for daily living in Shinyanga Region, Tanzania. Eligible women were  $\geq 18$  years old and passed a study recruitment site carrying a load. We collected information on load-carrying practices including frequency and time spent carrying water, wood, agricultural products, coal, sand, and rocks, and measured the weight of the load carried on the interview date. Outcomes included self-reported MSDs, defined as experiencing pain lasting  $>3$  days in the neck, head, back, knees, feet and/or ankles within the last 1 year, and disability, defined as having difficulty completing activities for daily living due to pain within the last 1 year. Using multivariable logistic regression we assessed for associations between load carrying exposures and MSDs and disability.

### **Results**

Of 132 individuals assessed, 125 were eligible and 82 consented to participation. On the interview date, women were carrying water ( $n=51$ ; 62.2%), wood ( $n=17$ ; 20.7%), or agricultural products ( $n=14$ ; 17.1%). Average weight of all loads was 18.8 kg (SD: 5.8): water weighed an average of 18.9 kg (SD: 4.4), wood 20.9 kg (SD: 9.3), and agricultural products 16.2 kg (SD: 4.6). Reported frequency and duration of load carrying varied by the material. For example, on average, wood was collected 1.4 times/day (SD: 0.8), 2.4 days/week (SD: 1.6), with an average trip time of 81.2 minutes (SD: 53.1), while water, with an average trip time of 18.8 minutes (SD: 12.3) was collected on average 5.3 days/week (SD: 2.0), 4.0 times/day (SD: 2.0). Our outcome assessment showed a high prevalence of MSDs and related disability across body regions. Multivariable analyses primarily revealed associations between increased load carrying exposures and low back pain (LBP) and related disability, including statistically significant increases in odds of LBP with increasing weight (aOR: 4.21, 95%CI (1.22, 14.60)), total duration of load

carrying/week (aOR: 5.23 95% CI (1.48, 18.47)) and cumulative loads/week (aOR: 4.47, 95% CI (1.19, 16.74)).

## **Discussion**

Findings indicate a substantial burden of MSDs and disability in this population of women who carry many different types of heavy loads daily. Generally, we found that the extent of discomfort and disability increased with increasing exposure to various load-carrying measures, especially for LBP. Addressing this largely neglected topic has significant implications for the health and wellbeing of women in developing countries who carry heavy loads to care for their families. Larger epidemiologic studies to more definitively assess the relationships between load carrying, MSDs and disability are warranted.

## [1632] Work activity analysis to support technological aid supply in vocational training for adolescents with learning difficulties

Marie Laberge<sup>1,2,3</sup>; Aurélie Tondoux<sup>1</sup>; Marie-Michèle Girard<sup>1,2</sup>; Fanny Camiré Tremblay<sup>1,2</sup>

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**This communication is submitted to be part of the symposium “Ergonomic analysis of work activity and training: evolutions of basic paradigms and creativity in practices” (Santos and Degoulet)**

**Introduction:** Adolescents with learning difficulties are at risk of leaving school without a qualifying certification. They may experience difficulties in entering the labour market. In Quebec (Canada), the *Work-Oriented Training Path* (WOTP) enables these young people to develop their employability by offering pre-work traineeships in actual companies. The aim of this pilot study was to develop a training intervention addressed to teachers involved in WOPT programs. This training intervention relies on work activity analysis to elaborate a wise-oriented planning of technological aids to help students enrolled in the WOTP programs developing work skills.

**Methods:** Eight teachers and fifteen students enrolled in the WOTP participated in a multiple case study. Teachers first attended a training workshop on work activity analysis and were then asked to apply the approach to conduct workplace analysis in order to provide technological aids. They were invited to use the approach throughout the school year for two of their students. They were free to choose any applications. Each two months, a collective meeting was organized to share the various experimentations; the content of meetings was recorded and analysed. Additional data was collected along the study (log book, questionnaires, interviews). At the end of the study, teachers conducted a total of 46 work activity analyzes to grant technological aids (TA granting activity). The analysis of this material led to recommendations for future.

**Results:** The initial training workshop emphasized the importance of analyzing work activity before determining technological aids so that the choice takes into consideration the actual work. According to teachers' analysis, the principal needs of their students are related to spatial and temporal organization, execution speed, motor skills, communication difficulties, and learning transfer in various contexts. Teachers mostly used simple, usual and free apps, like calendar, notes, alarm functions, checklists, and few more complex apps that required programming, as My video coach, Shadow Puppet, Explain Everything. The main difficulties with technological aids encountered by teachers concerned the relationship with traineeship companies, implementation time and the degree of involvement of students. According to participants, among the 46 TA granting activity conducted, the ones that engaged the students more actively (e.g. he/she has his/her own digital assistant, he/she can program it him/herself, he/she participates to his/her own work activity analysis) seem to provide better outcomes in terms of skill development.

**Conclusion:** Work activity analysis is a useful mean to determine which technological aids are worthwhile to support employment integration, but this analysis should continue beyond the identification of student needs, at the time of implementation and follow-ups.



**[893] Using a sex/gender lens when designing participatory research in occupational health. What can we learn from the GESTE>pour le partage des connaissances team's past experiences?**

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Introduction: The *GESTE>pour le partage des connaissances* team (French acronym for *Gender, Equity, Health, Work and Environment>for knowledge sharing*) was created in 2017 in order to study the impact of including a sex/gender (s/g) conscious approach when designing knowledge translation interventions (KTI) in the field of occupational or environmental health (OEH). As a first step, the team is determining what it means to have a gender-sensitive approach in KTI. To do this, the team has conducted a retrospective analysis of its past intervention-based studies in occupational health.

Objective: To critically analyse different ways of considering sex and gender (s/g) in intervention-based studies conducted by the scientist members of the team. The resulting categorization will be used to develop indicators for the evaluation of integration of s/g in KTI in the field of OEH.

Methods: The team includes 15 occupational health scientists, including seven ergonomists and 13 specialists from other fields involved in intervention studies aimed at improving working conditions. A preliminary list of studies that included an intervention to improve working conditions was collected. Each study must have had, to some extent, included sex or gender consideration (regardless of form or intensity). A thematic content analysis was performed to identify the different ways of considering s/g in this corpus of studies. Two data sets were used: 1) table with a list of studies based on brief summaries (list of partners and stakeholders involved, their needs, background or social demand for the study, brief description of s/g integration, findings and outcomes, in terms of workplace or social change) and 2) narrative interviews with concerned scientists. The themes covered were triggers, obstacles, and facilitators in considering s/g, and the opinion of the scientist about different facets of the study (positive vs. negative outcomes, critical analysis about s/g considerations, etc.)

Results: The findings showed that some intervention-based studies initially focus on a s/g related issue (e.g., a comparative analysis of working conditions for so called "heavy vs. light" housekeeping jobs –held respectively by men and women), while for others, the s/g appeared along the way. In many studies, the integration of s/g has not been included without pitfalls, and outcomes that have resulted have not always been favorable to women. Moreover, attention to s/g integration does not always translate into action or workplace improvements. Finally, s/g integration in occupational health interventions is the result of a social constructs and depends on power relationships between stakeholders, including scientists.

Conclusion: The findings have led to the identification of different indicators of s/g integration in intervention-based studies. The next step will be to conduct an evaluation study to determine different outcomes associated with the integration of s/g in KTI in the field of OEH.



## [3272] EXPERIENCES IN THE DEVELOPMENT AND IMPLEMENTATION OF AN ACADEMIC MASTER DEGREE IN ERGONOMICS IN MEXICO

Rosalío Avila Chaurand<sup>1</sup>; Lilia R. Prado León<sup>1</sup>; Elvia L. González Muñoz<sup>1</sup>; Irma Landa-Avila<sup>1</sup>

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### EXPERIENCES IN THE DEVELOPMENT AND IMPLEMENTATION OF AN ACADEMIC MASTER DEGREE IN ERGONOMICS IN MEXICO

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#### **Abstract**

Due to increasing demands for ergonomists and to the scarcity of educational offers in this field in Mexico over the last 15 years, an Ergonomics Master degree was created at the University of Guadalajara. Based on a national market survey, on a review of the requirements of professional certification agencies in ergonomics in USA and Europe, and on a review of the program contents of ergonomics master's degrees in other countries, the conceptual structure of the areas of knowledge and application of the discipline lead to a two-year study program designed with two specializing orientations: Design Ergonomics and Occupational Ergonomics. After some time, 90% of the students enrolled in the courses of both orientations, so it was decided to merge the two orientations, both successful today. Graduates have been able to find jobs in universities and educational institutions, and in companies and industries from the region. The program consists of 22 courses with a total of 1,100 contact hours, 308 hours of after-school study and 200 hours for the development of a thesis. The courses cover the essential aspects of Physical Ergonomics, Cognitive Ergonomics and Organizational Ergonomics. Visiting professors with a high academic profile teach several of the courses, from countries such as the U.S., Spain, Brazil and Chile.

The creation of the postgraduate program was possible thanks to a group of professors who founded an Ergonomics Laboratory in 1987, which in 1997 became a Research Center. They began a self-training process through courses taught by foreign professors. They started to do research and also teaching processes at the undergraduate and postgraduate levels. Thus they acquired the necessary knowledge and skills design and implement a postgraduate program. The attendance of these professors in national and international ergonomics congresses enabled the contact with other institutions and professors from foreign universities that show a very high availability to participate and actively collaborate in the process.

University officials understood the project and supported it from the beginning. Even with ups and downs the training process was followed: one of the professors could undertake his doctorate in ergonomics at the U. of Loughborough, one of our first graduates is also starting there his PhD, and another graduated student studies at another university in the UK.

We are aware of IEA's efforts in favor of ergonomists training, but we would have appreciated greater support to incorporate first level visiting professors in diverse areas. The postgraduate program has been maintained for 4 generations. We hope to start a doctorate in collaboration with other universities in the world, and that the political changes coming in our country will favor the arrival of honest officials who understand the importance of supporting training processes in all scientific areas.

**Key words: Ergonomics; Professional Education, Postgraduate degree, Mexico**

## **[2058] Applied Cognitive Work Analysis to inform the design of an interface of a novel neonatal resuscitation device**

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### Introduction

International newborn resuscitation guidelines highlight the importance of using heart rate (HR) to guide resuscitation and stabilisation. However, HR acquisition methods can be inaccurate or technically challenging especially in preterm infants. A novel, hands free and wireless medical device has been developed to address this unmet need of an easy to interpret and reliable method of HR acquisition. A human factors (HF) approach was implemented in the design of the interface of this new device to understand the essential cognitive requirements of practitioners during neonatal resuscitation.

### Methods

The applied cognitive task analysis (ACTA) method was used to identify key tasks and cognitive requirements associated with neonatal resuscitation. Practitioners of neonatal resuscitation were recruited into two interactive scenario based workshops exploring potential errors, contributors to decision making and situation awareness during neonatal resuscitation. As groups and individually, mock up interfaces were produced based on essential and desirable requirements, encompassing both visual and audible cues. Data were analysed from the ACTA methodology and user needs workshop. Themes relative to essential and desirable characteristics for the interface were elicited and combined with recommendations from international standards to develop the final device interface design.

### Results

Participants consisted of doctors, neonatal nurses and midwives (n=12) with 1-30 years experience (mean 11yrs). ACTA identified the interpretation and reliability of HR, failure to recall normal HR values, estimation of time elapsed and recall of key events as potential errors during resuscitation. Essential characteristics for the interface were a central and bold HR display with colour change at key HR values (e.g <100bpm), an event marker and log to form an accurate record of resuscitation and HR PPG to allow visualisation of signal reliability. Interface designs were analysed to produce cumulative representations of the data (figure 1), a final heat map of visual measures and their preferred location. Alarms were considered useful as audible cues but required sensitivity in their design (e.g pitch and rhythm) to avoid undesirable consequences of anxiety to practitioners and parents.

### Conclusion

This study applied ACTA in a new domain, to understand user decision making and critical information requirements from an interface used during newborn resuscitation. The outcomes provide guidance on how a device interface can emphasise key information,

support cognitive tasks and minimise potential errors. The ACTA method with HF experts and medical device developers can be used when designing medical technologies for resuscitation use.

## [1631] Using Tangibles to Encourage Children's Reflection on Personal Health Data

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The proliferation of personal health sensors in wearable technologies and smartphones means that it is now possible to measure and monitor virtually every aspect of our quantified selves. However, oftentimes, we accept data from these devices at face value, without critically reflecting on the accuracy, reliability and privacy implications of the technology itself. As technologies become more ubiquitous and data is increasingly aggregated and shared between companies, there is a growing onus on everyday citizens to be more aware and critical about what types of personal health and wellbeing monitoring they choose to opt in to and out of.

The overarching aim of this research is concerned with teaching the next generation of technology consumers and innovators *digital fluency*—defined as the ability to not just use emerging technologies, but also to build habits of active reflection and dialogue about the status quo. A main subcomponent of this research concerns itself with tools to help children reflect on both their personal health and wellbeing data, and on the technology that gives rise to it. We aim to foster habits of asking questions such as: what insights can this sensor data give me about myself? Is the real-time data accurate? When would I want to keep this data private?

Our work utilizes a tangible interface, the *Magic Cubes* [1], which consists of interactive, Bluetooth-connected cubes that can be programmed and explored by children through mysterious, discovery-based activities. By augmenting the Magic Cubes with personal health sensors that track galvanic skin response, pulse rate, and step count, we propose new methods for teaching children to question and reflect on their personal health and wellbeing data. Using discovery-based activities grounded in the children's real lives, we suggest how tangible interfaces can be used to bring abstract wellbeing data to the real world, making the conceptual basis of issues surround sensing and privacy easier to understand, and encouraging active reflection on technology even in young children.

[1] CodeMe. 2016. The CodeMe toolkit. Retrieved from <http://www.codeme.io>

## **[3266] Education and Training of Ergonomists at the Université du Québec in Montréal: focus on the ergonomic intervention**

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### **Education and Training of Ergonomists at the Université du Québec à Montréal: focus on the ergonomic intervention**

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In September 1992, the Université du Québec à Montréal (UQAM) offered its first graduate program in ergonomics in the form of a 30-credit specialized diploma (called a *Diplôme d'études supérieures spécialisées*, or DESS) in ergonomic intervention. In September 2003, the Department of Kinanthropology instituted a 45-credit professional master's degree program in ergonomics. This program was developed on the basis of the academic requirements for professional certification of Canadian ergonomists.

The curriculum begins with seven courses (21 credits<sup>1</sup>[1]) pertaining to a variety of disciplines. These courses give students a body of practical knowledge related to human work (biomechanical, physiological, cognitive, social and organizational aspects) and to pre-intervention preparation (ergonomic intervention process, work environment analysis, and health and safety management).

Focused entirely on the implementation of ergonomic interventions, the next 9 credits are devoted to having each student carry out an ergonomic intervention. Professors provide a framework for the intervention through courses and workshops, enabling students to understand the intervention context, analyze work situations, develop a process adapted to the workplace, and promote workplace involvement. Upon completion of these 30 credits, students may obtain the specialized graduate diploma (the DESS).

The next level of studies (15 credits), which leads to the professional master's degree, involves carrying out or assisting in organizational change projects in the workplace. The students learn about organization design and management (ODAM), project execution, and how to write and present intervention reports and engage in reflective practice.

The two graduate study programs in ergonomics now fall under the Department of physical activity sciences. It has been, and still is difficult to convey the importance of the many hours that professors need to spend teaching and supervising the students' implementation of interventions in workplaces (945 hours) to foster their learning. This results in a major work overload for the two professors in charge of the programs, and in difficulty obtaining the support needed to create new

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<sup>1</sup>[1]. One credit corresponds to 15 hours of class.

positions for professors specialized in ergonomics.

These two programs have successfully trained ergonomists capable of carrying out interventions in workplaces in response to needs expressed by companies. The presence of a fieldwork coordinator, that is, a person who is in direct contact with the companies and who receives their requests, ensures the necessary learning conditions for students in fieldwork settings and helps build a network of companies having a better grasp of the benefits of ergonomists. The programs have also enhanced recognition of the profession, thus facilitating interdisciplinary projects both in companies and in research.

### **More information about the programs**

UQAM-DESS en intervention ergonomique en santé et sécurité au travail

<https://etudier.uqam.ca/programme?code=1851>

UQAM-Maîtrise en kinanthropologie, profil professionnel, concentration en ergonomie

<https://etudier.uqam.ca/programme?code=1850>

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## [956] A Relational Look at Gender: Social Network Analysis Contribution to Understand Collective Dimensions of Work Activity

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The World Health Organization (WHO) calls for reducing the gaps "between different groups of workers in terms of risks and health" (WHO, 2007). Certain sectors and types of jobs expose workers to significant risks such as physical and psychosocial factors to their occupational health and safety (OHS) (Vézina et al., 2011). Also, gender, age, race and social class can play an important role in the emergence of occupational injuries (WHO, 2007). Among other examples, high level of work-family conflict is related to psychological distress and compromises physical recovery (Lippel et al., 2011); hardship of work accelerates aging (Cau-Bareille, 2014); the training of young workers may not prepare them adequately to the risks pertaining to their work (Laberge et al., 2012); or, immigrant workers are exposed to increased precariousness and occupational hazards (Gravel and Premji, 2014). Therefore, it is essential to understand OHS issues involved in high-risk jobs, along with the role played by unequal power relations based on socio-demographic characteristics.

The approach developed in the ergonomics tradition of work activity analysis is particularly relevant to study OSH issues since its focus is to increase workers' operational leeway by transforming the problematic elements of the work situation (Guérin et al. 2006; St-Vincent et al. 2014). Focused on the person in activity, this approach poses a challenge when a problematic work situation has social dimensions that go beyond the analysis of individual activity (Caroly, 2016). The development of interventions promoting workers' health equity invites us to improve the ergonomic analysis model so that it formalizes social relations, through the collective dimensions of work (Laberge and Caroly, 2016, Riel et al., 2016).

This communication presents the theoretical and methodological aspects of an interdisciplinary approach, integrating organizational communication and ergonomics, to analyze workers' individual and collective strategies. We will first present how organizational communication models define workplace interactions, relations and their structure (Grosetti et Barthe, 2008). These models also help understand how gender and social inequalities are maintained in the workplace, both in the meaning given to work and in the materiality of working conditions (Ashcraft and Mumby, 2004). Methodologically, we propose social network analysis (SNA) as a complement to ergonomic observations of work activity in order to take into account the structuring effect of gender relations and power dynamics on work activity. SNA has been considered to analyze ergonomics interveners operational leeway (Coutarel et Petit, 2009) but not directly for the analysis of work activity.

Results from an interdisciplinary research integrating communication and ergonomics conducted in the cleaning department of a transportation company (Lefrançois et al. 2017) will help illustrate a relational perspective of gendered workplace and how SNA helped analyse of interactions but also the structure of relations related to work activity.



## **[1560] The activity analysis for accompanying industrial craft companies to the challenges of the market and of internal changes**

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### **Symposium “Ergonomic analysis of work activity and training: evolutions of basic paradigms and creativity in practices”**

The industrial craftsmanship of the Riviera de Brenta is transforming in parallel to a change in the needs of the market and the customer (the international fashion brands) and the introduction of new organizational systems according to the 4.0 factory paradigm.

Historically, the mastery of the artisan was expressed in the autonomous and creative process that guides the complete realization of the shoe: having a cognitive image (Ochanine, 1981) of the final result of the technical artefact (Simondon, 1989), could intervene in progressive balancing between the numerous components of the shoe.

From '80s, taylorist organisation in tasks with a high level of specialization, had led the industrial shoemaker to automate action, thus losing the systemic vision and perception of the end result; the outcome of this labour organization entailed an attitude of lack of interest and responsibility for "what comes before and what comes after" the single task.

The recent technological transformations are profiling a new organization of processes, an advanced lean that supports the search for new strategies and interpretative and creative ways to realize the work (Pero, 2017): central is the widespread intelligent work among all workers, the quality, productivity and efficiency of the complex interaction between people and technologies, the development of a direct horizontal relationship between inter-functional teams, the activation of communities of practice (Lave and Wenger, 1991), which favors the circulation of technical knowledge, solutions innovative methods of improvement.

The main goal of the research, conducted from 2008 in the Industrial District (DI) of the shoe "Riviera del Brenta", Italy, and inspired by the theoretical and methodological framework of the Professional Didactics (DP) (Pastré, 2011) was the one to professionalize (Wittorski, 2007) the workers of the sector of the industrial crafts and to accompany them in the challenge of the organizational change through the realization of devices of transmission of the knowledge: the power of methods and techniques from the work and activity analysis, allowed to greater consciousness of the action, the development of the aptitude to the explicitation of the practices, the conceptualization of the implicit knowledge, to the capitalization and the transfer of the knowledge implied in the creative resolutions of problems in a collective heritage of effective knowledge.

Intervention and training projects carried out in ID firms have contributed to the individual level, the strengthening of the individual and collective professional identity, the increase of worker mobility in the ID; at the company level, improving production processes, as well as products; the development of the company as a creative agent of knowledge for action in unexpected and impossible situations.



## [2173] Experiencing sound through interactive jewelry and fashion accessories

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Design research in the area of disability has a profound opportunity to raise questions of embodiment to the benefit of all bodies. Mainstream research in disability study aims at integrating people with disability into society through a process of rehabilitation and standardization. Rather than combat individual shortcomings, our research aims at identifying discriminating conditions - such as communicative and cultural barriers and social attitudes - that produce exclusion of specific groups because they do not correspond to "empowerment" expectations [1].

We address disability as an opportunity for design by developing smart fashionable accessories and garments with and for a group of deaf women to offer opportunities of engagement, emotional well-being and comfort while reducing negative impact of the impairment. Assistive devices rarely reflect the human need for beauty, or a person's need to express their individual sense of style [2] [3].

The research has been developed in Quietude, a project funded by the EU research and innovation programme H2020-Wear Sustain-2017 (<http://wearsustain.eu/>). The program explores aesthetics, social and environmental sustainability through the development of wearable, embodied technologies [4]. Quietude addresses needs and desires of deaf women by developing an ecology of jewelry products and accessories that enrich the experience of sound in everyday life scenarios. The accessories detect sounds and translate them into vibrations and shape changes so that deaf women can perceive and appreciate the qualities of sound through their body. The jewelry collection is completed by an App for smartphone allowing embodied personalisation of both input and output (quality and intensity of vibration, movement and lights), and the construction of a personal library of sounds that can be monitored for, and replayed on demand through the accessories.

Early prototypes of the collection have been developed in co-design [5] and participatory research-through-design [6] sessions with deaf women to enable the development of accessories that reflect and respond to emergent discoveries and desires.

In the paper, we focus on interaction design and aesthetics of the accessories showing how they respond to needs and desires of deep deaf and hearing impaired women as emerged during co-design workshops. The jewelry collection shows an approach to design for disability which is concerned with the experience of the wearer rather than on developing a technological fix for a medical device.

*Keywords. Jewellery; Embodiment; Deafness; Co-design; Research-through-Design.*

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## **[2569] Methodologies and observation techniques in the practical exercise of research-intervention in ergonomics. Impressions from Chile**

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Based on the practice of the profession developed in the Unit of Ergonomics of the University of Concepción, and the experience for nearly two decades, at teaching and training different Latin-american students, is possible to identify some elements that characterize the methodology of observation and diagnosis of a workplace with ergonomic intervention purposes. This is relevant since most of the interventions in Chile are just focused in symptom, are reactive, non-systemic and with a poor participation in any stage project development.

The common scheme is that an organization hires an ergonomist when they have a problem and, as it has been described by Guérin, Laville, Deniellou, Duraffourg & Kerguelen (**2009**), the problem is understood and identified by meetings, observations and interviews with operators in relation to what and how they perform their activities. These interactions also allow reformulating the demand. The model developed at the University of Concepción, focuses on the analysis of the activities of a worker, as part of a system that, as a whole, must be efficiently designed (Elías Apud & Meyer, 2009).

For this purpose, the aim is to characterize the worker and the job demands for the systemic understanding of the problem, through the analysis of four workloads: the physiological, mental, environmental and organizational (E. Apud et al., 2002). Also, a participatory strategy is adopted, based on the contribution of workers, supervisors and managers both at identifying the problem and at analysing improvement proposals. It is considered that observation in work situation is one of the most important techniques, complemented with interviews and traditional work study methods. Other supporting tools complement the observation in work situation and the research of information, but it is the ergonomist who decide that will be chosen according to the relevance of what is under analysis to understand the dynamics of the work and the worker with their regulations and joint actions.

Nowadays, the problems and challenges in Chile related to diagnosis could be summarized in: a) the policy and regulations related to occupational health and safety, which limit the understanding of the problem; (b) techniques and instruments of measurement, that privilege quantitative data over qualitative data; (c) tendency of early diagnosis, rather than observe and describe; (d) lack of triangulation and systemic integration of information under research; (e) not specific recommendations for intervention; (f) lack of knowledge of the ergonomists role by the organizations; (g) lack of ergonomists inside the companies; h) the scarce chance of materializing and monitoring the improvement proposal. Finally, the ergonomist needs to develop a common language with the companies to consider the benefits at investing in ergonomic proposals and professional coaching to ensure quality, safety, well-being and integral development of work environments.



**[3223] Development and validation of an integrated robotic platform for upper limb motor rehabilitation and visuomotor coordination in virtual reality scenarios including activities of daily living**

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**Development and validation of an integrated robotic platform for upper limb motor rehabilitation and visuomotor coordination in virtual reality scenarios including activities of daily living**

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**Abstract**

Reintegration into working life following a traumatic injury or disease is a multidimensional process involving both physical and psychosocial aspects [1]. In particular, for those professions requiring strength, movement control and arm dexterity, recovery of upper limb performance is a key factor for a successful reintegration into working life [2]-[5]. In order to promote the recovery of upper limbs functions following neurological injuries, different rehabilitation approaches based on the use of robotic devices able to support the execution of repetitive tasks oriented to carry out specific motor

tasks have been recently developed [6]. Usually the proposed exercises are “*goal-oriented*” and in some cases functional movements may be also practiced [7].

A clear evidence that such approaches may contribute to improve muscular strength and motor coordination in patients affected by neurological impairments has been found: at the same time the impact of these approaches on the patients abilities to carry out activities of daily living (ADLs) is yet rather limited [8].

The recovery of functions needed to carry out ADLs represents one of the main objectives of workers rehabilitation as it can restore a greater autonomy and an increased ability to perform specific tasks [9].

Currently rehabilitation programmes and processes of reintegration into working life are poorly focused on a) the subject personalised objective assessment based on his/her own residual abilities and 2) recovery of skills needed to the subject redeployment.

On the other hand a rehabilitation training enriched with virtual reality (VR) scenarios can be used to ensure the execution of repetitive tasks together with sensory-motor feedbacks in order to promote neuroplastic processes needed to re-learning and motor recovery [10].

Based on the above mentioned assumption, the main objective of the RoboVir research project is the design, development and validation of an integrated robotic platform including wearable sensors for motor rehabilitation treatments delivery and upper limb visuomotor coordination in occupational contexts. The integrated technologically advanced platform will be used for the assessment of upper limb residual functional abilities and rehabilitation oriented to working movements recovery in patients affected by:

- injury due to working accident on upper limbs;
- diseases following upper limb biomechanical overload due to working origin;
- neurological and other diseases threatening upper limb performance during working tasks.

The specific objective of the RoboVir project is the development and validation of an integrated technological platform formed by 1) a 7-degrees of freedom end-effector robotic device, 2) a set of wearable sensors for upper limb biomechanical analysis, visuomotor coordination and tactile sensory reintegration, 3) VR rehabilitation scenarios supporting upper limb and visuomotor coordination exercises and 4) a robot adaptive control strategy based on upper limb biomechanical features and visuomotor coordination of the injured worker.

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## **[2724] Teaching with gender perspective oriented to the training of women students of Interactive Design and Interactive Technologies**

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This proposal is based on the need to develop studies for a teaching with gender perspective oriented to the training of women students of Interactive Technologies and Interactive Design. Training of women designers and technologists, who will have the task of developing easy-to-use, useful and pertinent systems but above all, consider the transition towards a more social design characterized by: giving people voice, centering results of the design processes in users; thinking about the consequences of actions (natural, cultural, economic and social); taking into account consumption of materials and energies; considering solutions offered are thought in the context of the people; and focusing on services, rather than products.

At present, society is characterized by marked economic, social and gender differences; some of these are visible in the phenomenon known as digital divide, in which the same opportunities for access and use of digital technologies do not exist for all individuals. The obstacles to economic and geographical access, as well as the difficulties of using new technologies are widening the digital divide between people; differentiating between those who may or may not acquire a series of products or services, between the countries that develop technology and the countries that adopt it, as well as between men and women who use technologies; that is to say between "what some do and others cannot do". Historically, women have been lagged with respect to men in the digital domain. These differences have been built from the family, education and social recognition, giving cultural, social and gender legitimacy. The 2015 National Survey on Availability and Use of Information Technologies in Households (ENDUTIH) revealed that 55.7 million people are users of a computer and 62.4 million use Internet in Mexico, Nonetheless, when considering the use of Information and Communications Technologies (ICT) by gender, the results showed an equal participation between women and men. Despite the possibility of equal access to ICT, the social and personal valuation of skills between women and men is distinctive, although girls can use the computer equally, in terms of time and skill, imaginary representations about the computer expert remains masculine. It is important to visualize scenarios to define the characteristics of a gender education in which the social self-concept and the self-image of women develop positively, promoting experiences that benefit the students that develop products designed with women who have had little access to ICT by making efforts to prevent increasing digital divide by gender.

## [517] Why do we often forget gender in ergonomic interventions?

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The Université du Québec à Montréal has signed agreements with community groups providing access to help with research and training initiatives. A joint university-community steering committee makes sure that the projects meet both community needs and university standards (Messing 2014; preface). From 1993 to 2010, a union-university partnership performed research aimed at improving occupational health and gender equality. Called "*L'invisible qui fait mal*" (IQFM), the team was composed of researchers in ergonomics and legal sciences as well as union representatives from women's affairs or health and safety (Messing and Lippel 2015). A new team, called SAGE (Santé, genre, égalité) is now building on this early work (Riel et al. 2017).

Over its 17-year lifetime, IQFM responded to almost twenty union requests for action-oriented ergonomics research on jobs marked by a gender division of tasks and health and safety risks (Vezina et al. 1995; Messing 1998). IQFM and other practitioners have suggested examining gender at each stage of interventions, from the initial request to devising solutions (Messing 1999; Vézina et al. 2016; Laberge and Caroly 2016; Chappert and Théry 2016). However, in several instances, gender was "forgotten" during an IQFM ergonomic intervention. For example, we observed cleaners for several shifts, noting that some surfaces were hard to dust and other surfaces too cluttered to mop, but omitting gendered assignments. Another time, an ergonomist member of a steering committee of a study publicly rejected the idea of a gendered division of tasks and risks, six months after commenting on versions of and approving a study extensively documenting the division (Messing 2017); he had forgotten the results he had endorsed.

Reasons for this blindness may be fourfold: (1) Ergonomists, particularly those in the work activity analysis tradition (St. Vincent et al., 2015), are trained to analyse work, not workers, and to observe the work of a variety of workers so that individual differences "disappear." (2) Ergonomists work with small data sets, so that statistical comparisons of women and men is not feasible. And, within these data sets, women and men do not fall into distinct categories (Messing et al. 2016). (3) Ergonomic intervention is directed toward identification of risks and immediate transformation of work activity; gender is not usually a risk or a transformable element. (4) Gender and other power relations are often taboo subjects in the workplace (Lacomblez et al. 2016; Riel and Major 2017); it is unlikely that employers will accept changes in these relations as an outcome of an ergonomic intervention (Chappert et al. 2014). The communication will discuss by what methods and at which times gender can be brought to mind during an intervention, as well as the results obtained.

## **[1725] Biomechanical overload evaluation in manufacturing: a novel approach with sEMG and inertial motion capture integration**

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Biomechanical overload represents one of the main risks in the industrial environment and the main possible source of musculoskeletal disorders and diseases. Current risk-assessment methods are mostly observational and not based on objective measures of risk factors.

The aim of the study is to introduce new technologies for quantitative risk-assessment of biomechanical overload, by integrating surface electromyography (sEMG) with an innovative motion-capture system based on inertial measurement units (IMU).

The case study was carried out in collaboration with Fiat Chrysler Automobiles Italy S.p.A. and dealt with the analysis of the "central tunnel cabinet assembly" activity, performed by two workers of assembly lines. The electromyographic signals were acquired bilaterally, in three different body regions on the right and on the left side of the *Erector Spinae*, during standard working activities, by means of the FREEEmg 1000 (BTS, Milan, Italy) equipment with a sample rate of 1kHz. Workers performed three maximum voluntary contraction tests (MVCs). Electromyographic signals were rectified, filtered and normalized to MVCs.

The progression of trunk postures (flexion-extension, lateral flexion and twisting) was tracked by using an inertial motion-capture system, implemented by the University of Campania "Luigi Vanvitelli", made of wearable inertial sensors, which evaluate the alignment of the major body segments by using a developed algorithm.

The investigated activities were performed during a working task, which lasts about one minute. Data analysis showed kinematic and muscular activity patterns consistent with expected ones. In particular, they show that the proposed technologies can be integrated and simultaneously used during a workers' real performing activities. Data quality also demonstrates that both types of sensors, EMG electrodes and IMU, were not influenced each others neither by electromagnetic noise usually present in an industrial environment.

Results of this study show feasibility and usefulness of the integration of kinematic and electromyographic technologies for assessing the biomechanical overload in production lines.

## **[3830] Context Validity as a Critical Element of Forensic Site Inspection**

Ian Noy

# **[2141] Impact of a schedule management system on work/family balancing: the case of bus drivers**

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## **Background**

In 2003, the public transportation company of a city in Switzerland implemented a new schedule management system for its bus drivers, introducing an individualisation of working schedules. This innovation followed an ergonomic intervention including a participative process. Its main goal was to reduce the hardship due to atypical schedules by offering an individualised planning of schedules and a better repartition of work and rest times. In the new system, the drivers define their schedules five times a year, choosing among various working days and schedules available. Their turn in the planning depends on their seniority, with the aim to promote healthy aging in the workplace.

## **Objectives**

We conducted an independent academic study, supported by a grant of the Swiss national science foundation, in order to analyse the impacts of the individualised schedule management on the work/family balancing of bus drivers and the way they protect their health.

## **Methods**

The qualitative data collection, approved by the company's direction, took place from 2012 to 2014. It included 20 semi-structured interviews with drivers and 23 observations of schedule planning. The non-representative sampling aimed to reach a diversity of participants in terms of gender, seniority and family configurations.

## **Results**

Interviews and observations show that the new schedule management system has profoundly changed the conditions of work/life balance. Private life has become a key organizer of working schedules for all but one driver met in the study. The system has thus challenged the male model of times organization, that formerly prevailed in the profession, in which imposed working schedules determined private life. A great majority of drivers also tries to arrange schedules in agreement with regular sleep-wake cycles and with their own preference for morning or evening work.

However, the data shows that the drivers' experiences differ according to their seniority and the daily organization of their family. Drivers who take care of children beside their job prioritize the needs of their family at the expense of their own need of resting time.

Because these drivers are often newer on the job than drivers without family obligations, they have little choice in their schedules and are forced to make compromises that might affect their physical or mental health.

## **Conclusion**

The individualized schedule management has challenged the gendered models of times organizations, but it has also created new inequalities among the drivers. Difficulties experienced by drivers with children might account for the fact that the new system did not lead to an increase in the rate of women drivers. An open-ended question is now how the company could take into account the reality of care work in order to improve the situation of drivers with children, especially those who are new on the job.

## [3221] Wearable sensors for biomechanical risk assessment

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### Title: Wearable sensors for biomechanical risk assessment

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**Introduction:** work-related musculoskeletal disorders (WMSDs) are a growing concern for workers health and safety. In Italy the annual incidence has shown a constant growth and in 2016 WMSDs represented the 68% of the total occupational diseases (*INAIL Open Data, <https://dati.inail.it>*). Among critical work activities manual liftings and repetitive activities are the most demanding (*Le et al., 2017a, 2017b; Anderson and Oakman 2016, Waters et al., 2011; Marras et al. 2010 a and b, 2009*). The strength of traditional approaches for biomechanical risk classification is based on their inexpensiveness and not invasiveness. On the other hand, these methods have also some weaknesses due by their observational feature and subjectivity (*Peppoloni et al., 2016*). We hypothesize that instrument-based techniques using sensors attached to the worker segments and muscles could be able to capture some or all of the parameters needed in the calculation of the risk level by increasing the accuracy and reducing the time of the evaluation. The aims of our study were to develop an instrument-based method for direct biomechanical risk evaluation in lifting and repetitive activities.

**Methods:** we used miniaturized wearable technologies such as inertial measurement units (IMUs) and surface electromyography (sEMG) sensors and investigated two different work activities: liftings and repetitive movements. In lifting tasks a time-varying multi-muscle co-activation index (TMCi) (*Ranavolo et al. 2015*) and a lifting energy consumption (LEC) index (*Ranavolo et al. 2017a*) have

been calculated in activities designed to have a growing lifting index computed by the revised NIOSH lifting equation. In repetitive movements we investigated the association between the local elbow flexor muscles fatigue (*Farina and Merletti 2003, 2004*) and physical demand.

**Results:** as regard lifting activities it has been shown that heavier conditions resulted in higher TMCi values (*Ranavolo et al. 2015*). Furthermore, findings show that the LEC index grew significantly with the lifting index, discriminates all the risk condition pairs and well correlates with forces that determine injuries at the L5-S1 joint (*Ranavolo et al. 2017a*). As regard repetitive movement findings show that local muscle fatigue estimated by using sEMG probes on the brachioradialis is sensitive to the risk classes (*Ranavolo et al. 2017b*).

**Discussion:** IMUs-based lifting tool designed according to the RNLE and using co-activation and lifting energy consumption indices could be applied in indoor and outdoor work environments for risk estimation. Results obtained by the sEMG perspective highlight how heavier lifting conditions resulted in higher segmental and global sEMG indices (i.e. ARV and time-varying multi-muscle co-activation function) and how these sEMG variables strongly correlate with compression and shear forces and internal moments at L5-S1 joint. These findings suggest that also a sEMG-based tool could be used for biomechanical risk evaluation in lifting activities. Also fatigue indices are promising in biomechanical risk evaluation.

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**[2570] The analysis of tutor/trainee cooperation in work-based training situations: which creative process for tutorial interactions in care situations? An example in the field of medical radiology at the hospital**

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The oral presentation is linked to the symposium whose title is « **Ergonomic analysis of work activity and training: evolutions of basic paradigms and creativity in practices** ».

Abstract:

This communication is part of an ongoing research programme involving several teams led by the "Work & Training" pole (RIFT laboratory, University of Geneva), in partnership with the Geneva University Hospitals (HUG) and the Geneva High School of Health (HEdS). The contribution of our team "Interaction & Training" in the research program "Becoming X-ray technicians" focuses on the conditions for carrying out practical training for trainees and the modalities through which the transmission between experts and novices takes place on the workplace.

At the crossroads of Work Analysis from a Francophone ergonomics perspective (Leplat, 1994; Teiger & Lacomblez, 2013), Workplace Studies to analyse collaborative teamwork practices (Luff, Hindmarsh & Heath, 2000; Heath & Luff, 2000), and Ethnomethodology and conversational analysis (Hindmarsh & Pilnick, 2002,2007; Heath & Luff, 1992; Goodwin, 2013; Heath, Luff & Svensson, 2005), our communication emphasizes on cooperative activities arising from the management of a patient in a conventional X-ray room at hospital by a team composed of a mentor and a trainee.

We stress on the social and interactional organization of this team whose activity is patient-oriented and technologically mediated, to characterize the form of cooperation that is emerging during this guided radiological examination. The analysis is focused on the interactions between the technicians, who should coordinate themselves to deliver treatment to the patient and obtain a quality image.

We start from an ergonomics analysis activity-oriented based on video-ethnographic observation of work, and we build on the contextual analysis of interactional organization. The production of a radiological image requires mutual attention to the activity of the colleague. The expert has a specific commitment because he assumes at the same time a mentor's role that forces him to perform guidance indexed to highly contingent practical problems that emerge during work, and a sequential evaluation of trainee's operations with the machine. The expert's activity is characterized by a multi-focalisation (Goffman, 1981) which is manifested through various multimodal procedures.

This contribution involves understanding on how the novice's training transforms the realization of the work activity, and characterizing the forms and varying degrees of visibility of these issues over the activity. We show creative process implemented by

experts in mentoring interactions under which trainees learn to become medical radiology technicians in hospital. We highlight different forms of resources created by cooperative activity in the care situation with the patient, promoting the development of the trainee's skills. Eventually, we discuss the role of activity analysis in workplace training programs.

## **[2480] Challenges in implementing inclusive participatory OHS management approaches sensitive to gender and diversity issues**

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**Purpose :** Although the effectiveness of participatory approaches in occupational health and safety (OHS) is, in theory, widely recognized today [1, 2], their implementation is sometimes guided by power relations or by the interests of the most vocal stakeholders to the detriment of others. Several challenges remain to implement it fully in the workplace and to achieve the active, inclusive and representative participation of all stakeholders in terms of gender and, more broadly, diversity (ex. ethnicity, language, age, (dis)abilities) [3, 4]. The research question of the present study was : What are the favorable and unfavorable conditions for implementing inclusive participatory OSH management approaches that integrate gender and diversity issues?

**Methods:** We conducted an iterative scoping review of the literature following Arksey and O'Malley's guidelines [5]. We searched several databases including Pubmed, PsycInfo, Web of Science and Google Scholar for discussion or research on diversity management in participatory approaches in ergonomics and in OHS management. Papers were screened for inclusion based on their title and abstract at first and based on full text, as a second step. We performed a qualitative thematic analysis and synthesized the evidence and the questions/hypotheses/practical considerations raised in the discussion of the topic. From this analysis, we derived a conceptual framework.

**Results :** This research demonstrated the potential for participatory approaches sensitive to gender and diversity to overcome some of the limits of the classical OHS management approaches. We synthesized and discussed the principal barriers and facilitators to implementing inclusive participatory approaches in OHS and proposed a conceptual framework for the implementation of inclusive participatory approaches. Three dimensions were identified to a successful implementation of inclusive participatory approaches sensitive to gender/diversity : (a) establishment of a working group representative of the diversity within the organization, (b) integration of issues related to gender/diversity into the discussions, (c) establishment of a shared equitable decision-making process (ex. commitment of all stakeholders, exchange of information, skills acquisition in order to balance power relations). Various barriers and facilitators were identified on four levels: composition/functioning of the work group, values/beliefs/attitudes towards gender and diversity, social climate, financial/human/operational resources.

**Conclusions:** Understanding and addressing the principal barriers and facilitators to a greater inclusion and diversity in participatory approaches could ultimately lead to improved participatory interventions to everyone's benefit.

## [1515] “Let’s talk about Gender.” Reflection on Theoretical and Methodological Contributions of Gender Studies to Work Activity Analysis.

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Gender refers to the socially constructed characteristics of women and men – such as social norms, roles and relationships of and between groups of women and men (Fausto-Sterling, 2000; Ryle, 2018). It also refers to the sexual division of labor (job segregation and gender-specific tasks) observed in workplaces in Canada and internationally (Calvet, Riel, Couture, & Messing, 2012; Kergoat, 2007; Rose, 2013). This sexual division of labor contributes to the fact that women and men workers are exposed to different risks resulting in different health problems (Messing, 2000; Vézina et al., 2011). In occupational health, several studies, in particular those of the team *Invisible qui fait mal* (Messing & Lippel, 2013), have shown the need to consider gender and the sexual division of labor in order to reduce inequalities and occupational health risks for both women and men. However, the ergonomics studies that our team carried out highlight that it is difficult to address gender inequalities and develop solutions with stakeholders in the workplace (Chappert, Messing, Peltier, & Riel, 2014; Messing, 2017; Riel & Major, 2017). It seems that both research and intervention approaches and methods currently used in ergonomics have limitations in considering gender and are not always effective in revealing or reducing gender inequalities (Riel, Saint-Charles, & Messing, 2017). On the one hand, one of the strategies advocated in the work activity analysis tradition (St-Vincent et al., 2011) is to make a sex/gender-based analysis, but it can contribute to highlighting gender stereotypes and even reinforce them such as observed during restitution interviews with workers in previous research (Riel & Major, 2017). On the other hand, because ergonomic activity analysis is traditionally focused on the person in activity, there may be a shift towards individual characteristics, like sex, and thus contribute to difficulties in accounting for gender relations and their effects (Vézina, Chatigny, & Calvet, 2016). In order to overcome these difficulties, it is necessary to develop interdisciplinary approaches and methods. Gender studies, and more particularly feminist sociology, constitute an interesting avenue to explore because of their common goal with ergonomics. Indeed, as in the work activity analysis tradition in ergonomics, gender studies also pursue a goal of transformation. They aim to transform gender relations in order to reduce gender inequalities. This paper aims to covers specific areas of convergence and divergence between those fields of study. More specifically, the theoretical and methodological contributions of gender studies to work activity analysis will be explore.

## [1770] Designing tangible interfaces for inclusive wellbeing

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*Keywords: Interaction Design, Design for Inclusion, Tangible Interfaces, Internet of Things*

We live in a world surrounded by objects and services that have been created by others for our use. In order to use these products we need to be able to interact with them.

To perceive we rely on our senses, and depend on our ability to cooperate and communicate with our motor system in order to process the information and emotions that we receive, resulting in a subjective appraisal of a product whether it might be an object or the graphical interface of a service. Regardless of his surroundings, man is normally equipped with a series of mechanisms that allow him to interact with his environment: a motor system to react, a sensory system to perceive change, a cognitive system to give meaning to the environment and to undertake action. Products are a part of this environment.

The present digital transformation is changing the way we relate to everyday objects. It also affects the role played by design as a means of exploring new scenarios and proposing innovative solutions.

Nowadays it is possible to enrich any object or material with electronic components, according to the paradigm of ubiquitous and pervasive computing. This means that many types of objects, are becoming devices connected to Internet, able to perceive and disseminate information about themselves and the surrounding environment.

This revolution brings objects into a hybrid dimension, converging from a physical to an immaterial and intangible realm, composed of meanings and services. The electronic devices become part of our everyday lives, but on an invisible and imperceptible level. Little by little, our objects, our homes, and even our cities are acquiring the ability to communicate, which means interacting with us in a new way.

Changes in the interactive systems are followed by new, more tangible, interfaces, capable of making users feel more at ease with objects, since they are characterized by increasingly more natural and human interactive skills.

The design of computer systems able to change the way users react and think, in other words, persuasive technology, has potential in many fields of application. The new challenge for design is to investigate how these products, which are increasingly more intelligent and gifted with greater emotion and personality, can improve the quality of life of their users and the environment in which they live in order to respond to what they really need, and to favor the inclusion of more fragile users (such as the elderly or the disabled).

This paper presents selected results achieved from research conducted by the Laboratory of Ergonomics and Design of the University of Florence (LED) and explores new possibilities for interaction between human beings and products related to everyday life.

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## [1517] Organizational ergonomics of Ris-Pacs

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Radiologic Department workflow management has become paperless and filmless, with a wide use of dynamic process as multi-planar reconstructions, volumetric navigation, and electronic decision support tools. Optimization of the human–computer interface has improved productivity, diagnostic confidence, and interpretation accuracy.

The switch to a digital environment has drastically altered the structure of the reading room with view boards replaced by a number of computer screens for workflow and for image display. Furthermore, the majority of radiologists spent more than 8 hours a day at computer terminals, with increasing possibility of musculoskeletal or neurologic injuries that result from continual repetitive motion, vibrations, like tenosynovitis, carpal tunnel syndrome, and cubital tunnel syndrome. Sustained or awkward movements in relation to the prolonged use of computer monitors could be responsible of eye dryness, eyestrain, eye burning sensation or conjunctival redness, blurred vision and prolonged headaches. Prolonged positions at computer terminals can also result in neck and low back pain. These symptoms have been defined repetitive strain injuries (RSIs) and computer visual syndrome (CVS).

Pay attention to these disorders is especially important as tired eyes and brains may be more likely to commit more errors and results of great clinical relevance for radiologists and other healthcare professionals, in terms of risk management and clinical governance.

New digital workplace in radiology presents many ergonomic challenges and mandate changes in the work environment. Ergonomic issues range from the structure of the reading room to background lighting and noise, to chair and monitor positioning, to mouse and keyboard design and placement. Literature describes that room layout have to be designed as an open environment, allowing easy interaction with other radiologists, with soundproof walls and sound-absorbing clouds above, as well as individually controlled lighting and mild ambient lighting, that should be indirect and overhead to avoid glare. Three monitors with one low-resolution monitor to view worklists and hospital electronic medical records and two high-resolution monitors to review imaging examinations reduce the need for body movements compared with setups in which more monitors are used. The ideal distance from the radiologist to the screen should be 50 to 75 cm, with a 5-mm font size.

The keyboard and mouse are particularly important in minimizing stress to the hands and wrists and have to be placed in a convenient location and at a comfortable height, with plenty of desk space available around them and few obstructions, to allow fluid movements. Ideally, these devices should be thin and flat to reduce wrist extension.

As important as environment results personnel training, with literature emphasizing that radiologists experienced a significant decrease in workplace injuries after ergonomic training. Even more successful is participatory ergonomics, in which radiologists themselves develop personalized ergonomic measures.



## **[3407] The new designer: process facilitator and widespread project abilities promoter**

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Symposium: 24U – Plurivers Design

“The new designer: process facilitator and widespread project abilities promoter”

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The development of a complex project is an opportunity to learn by doing, learn by doing mistakes, and reach rapidly the ability to direct the actors of the change, as the director of a movie who implements with great personality and sensibility the storyboard of a story full of pathos and scene shots.

Even if you find the courage to improve the changes in the company through experimental methodologies, the main scene shots are unawares played by the management that binds the activities creating interferences in the correct development of the process.

In this phase the facilitator becomes a defender of the project and of the customer staff, deciding to side with the innovation process: the bottom level of the company is aligned with the facilitator, and the director shall decide if and how to challenge the management or withdraw the activity to go on in the innovative process.

The Umania Innovation 24U Team in this occasion shows always resiliency: the solid ability is always to wrap the customer in an evolutive context that overcame the disruptive perceptions and carry on the process in a resilient and antifragile way. The resilient ability allows the staff to go over the difficulties imposed by the unforeseen and the antifragile ability helps to find opportunities in every unexpected event.

All this is possible but the facilitator/defender must have the ability to motivate correctly both the customer staff and the Umania Innovation 24U team.

In this way the customer staff is engaged on the trust of learning in decontextualized environments, out of the habits, while the innovation team is engaged on the trust of accelerating the process that will give concrete results.

“Bticino case history” the new perspective inserted in the process was the consideration of the User Needs. Changing the perspective caused in the company staff the necessity to re-consider the information about the users and the stakeholders, inverting the building process of the product, and starting the new slow construction of a User Centered Design sensibility.

The Umania Innovation 24U team to focus better the customer staff on the goal created tools and instruments that generated constantly outputs and results.

The director observes from above, and during the reiteration of the process, decides how insert new competences or avoid new experiences, or how accelerate the processes or slow the activities, or how to manage the feedback both team and staff to improve the output of project and the tuning of the process.

The hidden ally of all this activities, that allows the director to concretize the innovation process is of course the top management, that developed a long term vision giving to all the actors the possibility to fail in order to improve.

## [1505] Theoretical impact of integrated prevention intervention among health care workers: knowledge from the Pays de la Loire Study

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**Objective** Despite preventive efforts, healthcare workers remain at high risk of carpal tunnel syndrome (CTS) in France as in many countries. We aim to assess the theoretical impact of workplace-based primary interventions designed to reduce exposure to personal and/or work-related risk factors for carpal tunnel syndrome (CTS) among aide-nurses.

**Methods** Cases of CTS were assessed using regional hospital discharge records for persons aged 20-59 in 2004. Using work-related attributable fractions (AFEs), we estimated the number of work-related cases of CTS (WR-CTS) in high-risk jobs. We simulated three theoretical scenarios of workplace-based primary prevention for jobs at risk: a mono-component work-centered intervention reducing the incidence of WR-CTS by 10% (10%-WI), and multicomponent global interventions reducing the incidence of all surgical cases of CTS by 5% and 10% by targeting personal and work risk factors.

**Results** Nine jobs at high risk of CTS, including aide nurses were identified in the region, amounting to 1,618 [1,143-2,233] CTS cases (out of the 4318 registered in the region's population), of which 952 [488-1,575] were WR-CTS. Considering healthcare workers, only female aide-nurses were at high risk of CTS (AFE = 48.2% [38.4-58.7] with 382 [303-475] CTS (of which 184 [106-279] were WR-CTS). The 10%-WI, 5%-GI and 10%-GI hypothetically prevented 18 [11-28], 19 [15-24] and 38 [30-48] CTS cases among aide nurses, respectively. The corresponding hypothetical preventive efficiency was 4.7%, 5% and 9.9% for the 10%-WI, 5%-GI and 10%-GI, respectively.

**Conclusions** The simulated workplace-based 10%-WI had a similar impact than the 5%-GI for aide nurses characterized by a moderate proportion of WR-CTS. This suggests enriching ergonomic intervention aiming to reduce exposure to work-related risk factors (WI) with a specific intervention on modifiable personal factors based on health promotion (exercises and/or diet program). Such integrated strategies of prevention (GI) are expected to have higher preventive impact among aide nurses.

## **[1613] Self-management process after a work accident: a gender analysis**

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The return to the professional activity after a work accident corresponds to a complex process, whose trajectory quite often reveals inequality factors, particularly if we look at it from a gender perspective.

The project “Return-to-work after an accident: to overcome obstacles” carried out in Portugal together with the National Association of Disabled Workers Injured On-the-job, which encompassed 366 participants, 282 men and 84 women, revealed different results for men and women regarding the circumstances and the consequences of the accident.

To begin with, the findings show what numerous studies have already pointed out: men and women perform their activity in differentiated companies and production sectors (e.g. women are highly represented in Health and Social Support or Catering and Domestic Work; and men in Construction or Transportation and Warehousing). For that reason, they also tend to suffer from accidents with different characteristics. As far as men are concerned, such accidents result mainly from the loss of machine control or from handling tools and means of transport. Records show a significant number of injuries in the upper limbs, hands, trunk, back, belly, and lower limbs. On the other hand, for women there are more accidents resulting from falls/slips, or caused by movements subject to physical constraints, meaning a higher incidence of injuries in the upper and lower limbs.

The findings also bring to light specific aspects from the precariousness in the employment conditions that follows the accident. Therefore, if prior to the accident the salary was the main income for most participants, after the accident the main income comes mostly from an unemployment allowance in the case of men, and from a sick/accident pay in the case of women.

Regarding the data collected from the Nottingham Health Profile, the after-effects of the accident are not the so-called objective consequences, subject to medical evaluation. They also assume the form of pain (e.g. “I feel unbearable pain”; “I feel pain during the night”) and struggles in the physical mobility (e.g. “it is difficult for me to go up/down ladders and steps”, “it is difficult for me to bend down”) – and the less visible consequences of the accident are referred the most by women. Those incapacitating symptoms last in time; they are not tangible, nor easily diagnosed; their recognition is often compromised and it is each person’s responsibility to manage them.

The choice for assuming an analysis from the gender perspective gave a better visibility to the remaining inequalities in the incapacities caused at work, hence enriching and determining the identification of intervention means, particularly concerning the liable institutions in this field (e.g. Courts, Insurance Companies, Authority for Work Conditions), that is: in the work contexts, but also outside them.



## **[3747] The pilot evaluation of Resilience Management Guidelines in the DARWIN Project**

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### **The pilot evaluation of Resilience Management Guidelines in the DARWIN Project**

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#### **Background**

H2020 project DARWIN aims to build resilience management guidelines to support organizations managing critical infrastructures to develop and enhance their resilience in the context of crisis management. The project focuses on the Healthcare (HC) and Air Traffic Management (ATM), although other sectors are involved via a large DARWIN Community of Practitioners (the DCoP) and by taking into account the infrastructures that may suffer, as a cascading effect, the consequences of a crisis or emergency occurring in the HC and ATM domain.

#### **The guideline evaluation process**

The DARWIN Resilience Management Guidelines (DRMGs) can be accessed via a WIKI platform and are composed of so-called Concept Cards (CC), each one linked to a resilience management principle. The CCs suggest a number of actions that an organization managing a critical infrastructure should perform to revise or integrate its own policies and guidelines, in order to increase its level of resilience. The evaluation of the CCs included a variety of exercises, with the core part consisting of four pilot exercises conducted in Italy and Sweden, in collaboration with three end-user organizations participating to the DARWIN consortium. The organizations were ENAV (the Italian air navigation service provider), ISS (Italian National Institute of Health) and KMC (Centre for Teaching & Research in Disaster Medicine and Traumatology, Sweden). The feedback collected during the Pilot Exercises was the main input of a Summative and Formative Evaluation process used to determine which CCs required more improvements before the end of the project and which actions were recommended to implement them.

#### **The Pilot Exercises**

Three pilot exercises were organized in Rome (Italy) and one in Linköping (Sweden). Each of them was associated to a reference scenario, representing a situation of crisis or emergency:

- Pilot 1 “Aircraft crashing in urban area close to Major Italian airport shortly after taking off”
- Pilot 2 “Total Loss of Radar Information at Rome Area Control Centre”
- Pilot 3 “Disease Outbreak During an Incoming Flight”
- Pilot 4 “Collision between Oil Tanker and Passenger Ferry leaving Gotland islands in severe weather conditions”.

The scenarios were intended as representative situations to reflect on how to apply the principles and actions indicated in a selected number of CCs. However, the resilience practitioners involved in the exercises - and representing a large variety of organizations - were free to propose also different scenarios, based on their individual experiences. The exercises were organized in different

evaluation sessions, depending on the specific CC the attendants were asked to use and to the method adopted to get prepared to the management of the crisis. Some of these consisted of operative techniques, such as Command Post Exercises and Table Top Exercises. Others were more speculative in nature, such as checklist-based evaluations, used in the context of dedicated workshops.

**Project Website:** <https://h2020darwin.eu/>

## **ACKNOWLEDGEMENTS**

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## **[2001] A bio-cooperative robotic system to ensure ergonomic posture during upper limb rehabilitation in occupational contexts**

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## **A bio-cooperative robotic system to ensure ergonomic posture during upper limb rehabilitation in occupational contexts**

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### **Abstract**

Inappropriate work conditions represent the main cause for upper limb musculoskeletal disorders in many working professions [1]. The intensity of the gestures together with the often improper movements and postures can lead to long-lasting injuries, especially in the shoulder/elbow district [2].

In this context, robotics and novel technologies might represent a new frontier of devices able to treat such disorders to accelerate recovery of work-injured people and quick reinsertion in their workplace [3,4].

In fact, the possibility to perform task-specific and highly-precise movements as well as to monitor limb kinematics and human-robot interaction make robots a key-enabling technology for rehabilitation purposes in working scenarios reproduced through immersive augmented reality [5]. Moreover, the use of several monitoring systems allows supervising and, possibly, ensuring a correct and ergonomic posture during the execution of the tasks [6].

This work proposes a bio-cooperative robotic platform for rehabilitation in occupational contexts of patients with upper limb musculoskeletal pathologies [7]. Such a system consists of a redundant anthropomorphic manipulator, a purposely developed active arm gravity support, a multimodal interface and an augmented virtual reality. The robot-aided rehabilitation aims at restoring the full joints Range of Motion (RoM) and muscle strength with an ergonomic posture and with physiological muscles activation patterns. Personalization of the treatment is a prerogative of the proposed system; in fact, physiological and sensory-motor measurements are included into the control loop to create a rehabilitative scenario that is tailored to the specific subjects' needs [8].

To validate the system, a preliminary study on healthy subjects was carried out. EMG activities of upper limb muscles were recorded during the execution of predefined reaching gestures. Performance and fatigue indicators were extracted and an ad-hoc control strategy was developed in order to adapt the level of arm support to patients' needs and selected tasks [9,10].

The preliminary tests confirmed that the proposed system is able to provide an adaptive support to the patient's arm without affecting the physiological coupling of muscle activation patterns. Moreover, the use of the robot-assisted platform allowed subjects to execute highly controlled movements while maintaining an ergonomic posture able to limit the trunk compensatory movements during reaching.

Future activities will include the validation the proposed system with patients affected by shoulder disorders. In addition, the integration of such system with immersive augmented-reality scenarios [11,12] opportunely developed is expected to enhance patient's engagement and visuo-motor coordination during the rehabilitative sessions.

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## **[3270] Lessons learned from the Ergonomics Graduate and postgraduate training Programs from Portugal**

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### **Lessons learned from the Ergonomics Graduate and postgraduate training Programs from Portugal**

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Ergonomics education and training at the Human Kinetics Faculty (FMH), University of Lisbon is unique in Portugal and ensures the training of Ergonomists at the undergraduate, master's and doctoral levels. The degree on Ergonomics at the FMH was created in 1988 in response to business and social needs, both in terms of improving work efficiency and promoting health and safety at work. The Master on Ergonomics was created in 1999 and the PhD on Ergonomics in 1988. As the PhD on Ergonomics was created before the MSc, during those years, PhD candidates had to perform a capacitation exam before applying to a PhD program.

The education programs have suffered adjustments in order to answer the changes in the higher education models in Portugal but also to answer to the evolution and challenges of the work systems.

The main changes are related to the duration of the graduation in ergonomics related to the Bologna process in European countries and the orientation of some disciplines towards cognitive and organizational ergonomics.

The graduation and master levels fulfil much more than the minimum requirements asked by IEA and CREE. But Portugal wanted to go further with its programme and to develop a real professional class of ergonomists. That was the main aim when creating the three education cycles.

The main difficulties faced in the developing process were related with the social lack of knowledge or experience of ergonomics among the stakeholders of work systems. It was necessary to demonstrate the value of ergonomics in systems design and that was done based on the curricular field internships.

On the other way, the occupational health teams welcomed and integrated the ergonomists very successfully.

Please find attached the links to the FMH site where you can find the curricula of the different levels:

<http://www.fmh.ulisboa.pt/en/undergraduate/ergonomics>

<http://www.fmh.ulisboa.pt/en/master/ergonomics>



## **[1583] Observations: cross-eyes between an ergonomist and an occupational psychologist**

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### **SYMPOSIUM**

#### **"Observations in actual work situations : Is this method still a key part of ergonomics practices?"**

Observation is a common method in our two approaches, which are known to place their interventions and research in the co-construction of methodological frameworks with the actors of the world of work that call upon our respective expertise. Dialogues between the activity clinic approach and the activity ergonomics is part of the common history of our disciplines (Clot & Leplat 2005; Simonet, Caroly, Clot, 2011; Simonet & Chatigny, 2017). We propose to continue to feed it with our singular cross-eyes with the reciprocal objective of deepening, as far as possible at this stage of our debates, the questions of actions that drive us on how to define observation, its goals, the place it takes in the intervention, its modalities, its contributions sought for the various actors in the organization of work and its stakes in terms of transformations, efficiency and health at work. To do so, we will focus on scientific data issued from multidisciplinary collaboration with ergonomics got integrated into developmental methodologies from the Activity Clinic perspective in occupational psychology (Kloetzer, Quillerou-Grivot, Simonet, 2015). The Activity Clinic research is a psychological perspective inspired by the works of L. Vygotski and the tradition of Cultural Historical Activity Theory. It is currently developed at CNAM in Paris, France. In this frame, development is both the object of our research and its method: we try to provoke developmental events in order to study development mechanisms. We focus on development at the workplace: development of the working subjects, work settings, work tools, work relations, work objects... i.e, work activity. On its empirical side, the Clinic of Activity therefore aims at supporting the action of the practitioners in analysing and transforming their own work activity by creating methodological frameworks like « Cross Self Confrontations » or « Instructions to the Double ». These dialogical frameworks enable a co-analysis of the everyday work activity in a developmental perspective through various (re)mediations. For example in Cross Self Confrontations we use artefacts, among them and most importantly, video records of selected sequences of activity. So doing we expect to create conditions for a professional dialogue where professionals come to see their activity differently and gain greater power to act in and on their work situation and for a professional dialogue among decision-makers in the work organisation in order to impulse concrete transformations at work by questioning the current technical means available to employees thought by their managers. Our purpose is to compare our different methodological ways to stimulate transformations in a work organisation: these different methodological ways are based on different methods of observations.



## **[2758] Evaluating the treatment of sex and gender when assessing methodologic quality of studies in a systematic review of determinants of duration of work absence for WMSD**

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### **Evaluating the treatment of sex and gender when assessing methodologic quality of studies in a systematic review of determinants of duration of work absence for WMSD**

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#### **Introduction**

Sex and gender have profound impacts on work-related musculoskeletal disorders (WMSD) and on work disability arising from WMSD, with the greater burden on women with respect to prolonged work absence and

unsuccessful return to work (1-5). Approaches that take into account the contribution of biological (sex-related) and sociocultural (gender-related) influences on musculoskeletal disability are therefore necessary in order to achieve a more complete understanding of the reasons for this gender gap. In the context of a systematic literature review of determinants of the sex/gender difference in duration of work absence for WMSD, we developed criteria for assessing the treatment of sex/gender when evaluating methodologic quality of quantitative and qualitative prognostic or explanatory studies.

## Methods

A workgroup with expertise in sex/gender WMSD research within the study team developed criteria for assessing whether sex/gender were adequately addressed in primary prognostic studies, based on elements proposed by the Sex & Gender Methods Cochrane Musculoskeletal Group (6,7) and issues identified by others (8-11). Proposed items were discussed and agreement reached by consensus on their meaning and interpretation. Criteria for evaluation of risks to bias in quantitative studies in this review are based on the Quality in Prognostic Studies (QUIPS) instrument (12,13) and, in qualitative studies, based on the Methodology Checklist for Qualitative Studies of the National Institute for Health and Care Excellence (NICE) (14). The criteria developed for assessing sex/gender were then added to each of these two instruments.

## Results

We identified 16 sex/gender-related criteria to incorporate into evaluation of methodologic quality of primary studies: three address the research question or conceptual framework of the study (e.g. *study clearly articulates sex or gender differences/issues that are relevant to the research question or context*), five items address research design (e.g. *study describes recruitment strategies to accrue appropriate sample of men and women*), four pertain to analysis (e.g. *description of how sex/gender are handled is stated in the data analysis*) and 4 criteria address interpretation of results (e.g. *how results may need to be applied/translated based on sex/gender is considered*). Using selected studies from our review, we will present the 16 criteria and provide examples of how adequately or poorly various studies addressed these criteria. Each is rated as yes/partial/no/unsure.

## Discussion

The proposed 16 criteria were useful in identifying biases arising from treatment of sex/gender in the reviewed studies. The same 16 items can be used to evaluate both quantitative and qualitative prognostic or explanatory studies, and can be easily integrated into existing risk of bias instruments. They may be useful to others undertaking systematic reviews or to those planning and/or reporting prognostic studies.

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## **[799] School children's use of tablet computers and mobile phones is related to low back and visual symptoms**

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### Background

Since the development of television in the 1950s there have been ongoing concerns of the potential negative impacts of screen technology use on children's health and development. Recent technological developments in hardware, software and communications has provided mobile touch screen devices that are being introduced to enhance learning in many schools. However a description of current school children's exposure to these devices, and an assessment of potential associations with musculoskeletal and visual symptoms are lacking. Therefore the aim of this study was to describe the frequency and duration of various screen technologies by contemporary school children and assess associations with musculoskeletal and visual symptoms.

### Method

924 children (50% girls) from a socio-economically advantaged school completed the TechU-Q online survey during class time. Children were aged from 10 to 19 years (school grades 5 to 12). Descriptive statistics were used to characterise duration and frequency of use of multiple technology devices, including television, computers, tablet computers, mobile phones, and handheld and active and non-active console electronic games separately for weekdays and weekends. Associations between technology use and musculoskeletal symptoms in the last month (neck, low back and arms including forearms, wrist and hands) and visual symptoms were assessed using logistic regressions adjusted for gender and grade.

### Results

Mean total daily technology use was 212.8 minutes (SD 144.8) and increased from grade 5 to 11 then reduced slightly in grade 12. Mean daily use of tablet computers was 128.3 (142.7) for girls and 149.6 (150.5) for boys. Mean daily use of phones was 113.5 (146.9) for girls and 86.5 (134.1) for boys. Neck/shoulder symptoms in the last month were reported by 50% children, with 34% and 30% reporting low back and arm symptoms respectively. A mean of 1.9 visual symptoms (SD 2.0, from list of 9) were reported. Higher total technology (OR 1.10 per hour tech use,  $p=.002$ ) use as well as tablet (OR 1.07,  $p=.039$ ) and phone use (OR=1.13,  $p<.001$ ) was related to increased odds of low back symptoms. Similarly higher total technology (OR 1.07,  $p=.011$ ) use as well as tablet (OR 1.10,  $p=.001$ ) and phone use (OR=1.07,  $p=.021$ ) was related to increased odds of visual symptoms.

### Discussion

Screen technology use was substantial for the school children in this study. The increased risk of low back and visual symptoms, together with the substantial exposures, suggest promotion of wise use of technology should be a priority for ergonomics.

## **[858] The context of mobile touch screen device use by adolescents: A qualitative study of perspectives from both adolescents and parents**

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### **Background:**

With the emergence of mobile technologies, the use of mobile touch screen devices (MTSDs), e.g. smartphones and tablet computers, has become increasingly prevalent among adolescents. Concerns have been raised about the potential impact of this use on their health and development. However, research on the use of MTSDs is only evolving, and little is known about the context of how adolescents use MTSDs. Hence, this qualitative study explored adolescents' perceptions on the context of their MTSD use, including patterns, routines and type of activities on MTSDs. It also explored parents' concerns and perceptions on their adolescents' MTSD use.

### **Methods:**

Semi-structured interviews were conducted in English, with adolescents (n=36; ranging from 11 to 18 years) and their parents/caregivers (n=28) in Singapore. Eight adolescents were siblings with one another, hence their parents were interviewed in only one setting. Four parents were not interviewed as they did not speak English. Question prompts included the context of MTSD use - weekday and weekend patterns and routines (including breaks during usage, multitasking), types of activities, perspectives on extent of MTSD use, parental control measures and concerns (if any) regarding adolescent MTSD use. All interviews were transcribed verbatim and anonymized. Coding and development of themes from the transcripts were done iteratively using NVivo 11.

### **Results:**

Adolescents reported using MTSDs for a wide variety of activities, ranging from personal (e.g. messaging, social media, watching videos, playing games, daily functions such as setting alarm) to school work related (e.g. communication with schoolmates or searching information for homework). They also reported frequent and ubiquitous use of MTSDs, with patterns of use influenced by locations (e.g. school, home or community), schedules (e.g. weekdays versus weekend days), and tasks performed (e.g. multitasking with other tasks). Some of the factors which the adolescents reported to contribute to high MTSD use were lack of self-control or discipline, use of MTSDs for entertainment or relaxation to reduce boredom or kill time, and high use of MTSDs among peers, family members and for school work. The adolescents also reported factors that limited their use including

control measures from school and parents/caregivers, poor device functionality and lack of internet data availability. There was limited concern from adolescents on their amount of usage while parents expressed several concerns about excessive MTSD use.

### **Conclusions:**

MTSD use by adolescents was reported to be frequent and ubiquitous, with patterns of use differing between locations, schedules and tasks performed. Various other factors were reported by adolescents that can also affect the amount of their use, either by enticing them to use MTSDs more or limiting use. These potential influences of MTSD use may be important considerations when developing guidelines for wise use of MTSDs by adolescents.

## **[2484] Ergonomics in Design: the Human-centered design approach for developing innovative motor caravans systems**

Alessia Brischetto<sup>1</sup>; Giuseppe Lotti<sup>2</sup>; Francesca Tosi<sup>1</sup>

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Ergonomics and Design, precisely the relationship among Human-centered design (HCD) approach and Design for Innovation methods, represent a concrete growth strategy. European Union suggests design as a key discipline and activity to bring new ideas to the market, transforming them into user-friendly and appealing products or services. Though still often associated solely with aesthetics, the application of design is much broader. A more systematic use of design as a tool for Human-centred and market-driven innovation in all sectors of the economy, complementary to R&D, would improve European competitiveness. The paper presents the early results of the POR CReO-FP7 project "Triaca" developed with Triganò S.p.a. In Italy, recreational vehicles sector has always been present and active, however, in recent years motorcaravans industry recorded a strong decrease of orders due to the economic downturn and a flattened supply. In this context, the project aim is the development of innovative solutions in terms of environmental sustainability and quality of the user experience. Our contribution is focused on the experimentation of the HCD approach, especially its investigation methods based on the direct involvement of users and its evaluation methods for usability and safety to the development of good design solution.

As first activity we develop expert assessments through direct observation of a reference vehicle, referring our considerations about dimensions and movements to the scientific literature of the field. We consider motorcaravan as a complex system so, we decompose it into four main parts (living area, sleeping area, kitchen and toilet) to understand every part features and possible user ways to interact and, also, apply usability evaluation methods as better as possible. Secondly, in agreement with the UNI ISO 9241, we develop areas Task Analysis, considering main activities to be carried out within each area, to identify possible trouble. Based on the results obtained from the expert assessment, we scheduled a user trials session. We recruited different kind of users, in term of physical requirements, habits, skills, lifestyle and knowledge of the product, we performed the test within three different vehicles, to compare each other. During the session we produced a film which allowed us to analyze some aspect of user-environment interaction, such as cognitive and physical constraints. We considered, also, users thoughts, desires and expectations.

The processing of collected data and thoughts about contemporary lifestyles and people's approach to motorcaravan, allowed us to define new concepts. The latter involved solutions relating to the vehicle's internal environment, as for example solution for facilitate spaces transformation and promote efficient behaviors to saving resources. Finally, this experimentation produced a final concept of motorcaravan which was then translated by the company into a marketed product.



## **[990] Design for the lower limbs. A study for the development of an assistive robotic system for sensorimotor rehabilitation after stroke**

Francesca Toso<sup>1</sup>

<sup>1</sup>*Università Iuav di Venezia, Venice, Italy*

Stroke is the first cause of disability and the second of death in Europe, and on October 2017 the European Stroke Organization has released a “call on political leaders to recognise stroke as an EU-wide health priority and end inequalities in access to the current stroke management standards”.

Given the wideness of the target of patients affected by stroke and the impossibility to reduce them in a sample, the project has been focused on a development that accomplish the need of the therapists to start the rehabilitation with patient that for different reasons can not stand but have a good cognitive response: the lack of assistive devices for the rehabilitation for lying patients and the time needed for the discharge of the patient from a stroke unit to another ward are times of inactivity that can drive to a less effective recovery.

The paper will present the results of a doctoral research in Design Sciences in which the researcher has been studying the sensorimotor rehabilitation of lower limbs after stroke: based on the concept of neural plasticity and the possibility of complete recovery after stroke, the project concept has been built on the inversion of the technologically-driven dynamics of distraction to involve the patients in a flow driving to an optimal experience state, fostering the engagement through the gamification of the exercises and giving to the therapist the possibility to control and customize the levels of complexity of the stimulation.

After a desktop research on neurology, physiotherapy and engineering, an on-field observation has been conducted in order to identify possible areas of intervention. The design contribution consists in the preliminary development of an assistive robotic system for sensorimotor rehabilitation of lower limbs after stroke enhanced by a digital gaming and progress monitoring system to be used in an early post-stroke phase in which the patient is compelled to a bedridden condition. Attention has been given to the environment of use, the therapists as main users, the patients as secondary users and beneficiary of the interaction, the design and the usability of the system.

**[3395] The development of consciousness and responsibility processes in safety on the work place: The Pulverit Experience**

Raffaella Trigona<sup>1</sup>; Silvia Bernardini<sup>1</sup>

<sup>1</sup>*Umania srl – Stezzano KMR, Bergamo, Italy*

The development of consciousness and responsibility processes in safety on the work place: The Pulverit Experience

**Autori:** Bernardini Silvia/Trigona Raffaella

**Presenter:** Trigona Raffaella

**Affiliation:** Umania srl – Stezzano KMR – Bergamo - Italy

Working on ergonomics, make the difference in a lots of industrial approaches, especially for people who works in training field. What's important in training methods are not the results, but the people to whom the training is focused on. The paper we will present a big and complex training project, created and organized into a field of safety on working place in Pulverit Spa, a chemical firm, which produces powder paints. The training path indicates clearly the necessity to focus on people especially for the tangle of changes and innovations we're living (not only technological as Industry 4.0) and we have to face.

## **[1879] Transformation of work systems towards remotely supervised controlled work.**

Pernilla Ulfvengren<sup>1</sup>

<sup>1</sup>*KTH Royal institute of technology, Stockholm, Sweden*

The world of operational and work systems is changing not only because of increased commercial pressures to cut costs but also because the deployment of new technologies. Digitalization creates opportunities for new ways of organizing and managing existing work systems. Being able to achieve change and to design future systems are the core capabilities to meet future digitalization without compromising sustainable work systems. It is argued that the increase of automation and robots in these work systems calls for a new approach. Paradoxically with increased automation and more advanced technology it is now more than ever essential to view these operational systems as people systems. No matter what the degree of automation, people are involved, at some level of the system, in a co-ordination role. But many processes involving advanced technologies, as well as those with low technology involvement, are also essentially “people processes” with the functional links that produce the product or service being mediated or co-ordinated partially or entirely by people.

“Understanding the functionality of how such a system works is the key to managing the system more effectively, and to comprehending how it is possible to change the system to achieve better outcomes, or how to design a future system to operate in a way that transcends current practice” (McDonald, 2016).

The purpose of this study is to identify core challenges and affecting factors specific for transformation of various work systems due to digitalization. In this study examples of various types of systems transforming due to digitalization are described. The work systems described and analysed are piloting UAVs (unmanned aerial vehicle), remote air traffic control and remote work stations of technical experts in manufacturing. Each are different with respect to automation and human presence at the remote location or object and hence challenges differ for design and implementation for these systems. All require a fundamental shift in new work station design as well as work content.

The work system and process analysis needs to integrate various levels of people in the system, and the functional role of people in a system in which their activity make sense as well as the function between people and technology, in an integrated functional socio-technical system. A novel human factors model and framework called SCOPE, System Change and OPerations Evaluation (McDonald, 2015; Ulfvengren and Corrigan, 2015) will be applied to identify different elements and relations in the system in a systemic and systematic way, called a Structured Enquiry (ibid.). The framework comprises three interlocking, interpenetrated sub-systems—the functional process, social relations (teams and trust) and the role of knowledge and information logic mediating between these. This provides a strong basis for planning, evaluating and providing support to change initiatives and implementation.

## **[635] Levers and obstacles to the integration of sex and gender considerations in four ergonomic interventions: results from a process evaluation**

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**Presenter:** Nicole Vézina

**Human Factors and Ergonomics Domains:** Gender and Work

**Productive sectors and services:** Others

**Title:** Levers and obstacles to the integration of sex and gender considerations in four ergonomic interventions: results from a process evaluation

This abstract is meant to be part of the Symposium “Gender Work and Health in Ergonomics: Evaluating ergonomic interventions as a function of sex/gender-sensitivity “

### **Abstract:**

**BACKGROUND:** Work modifications tend to target more frequently male employees. Gender should thus be considered at various stages of an ergonomic analysis, in order to assist stakeholders in developing an action plan that will improve work situations for both women and men.

**OBJECTIVE:** To identify how gender is taken into account in the action plan of participatory ergonomic interventions integrating a gender-sensitive approach.

**METHODS:** Using a multiple case study design, a process evaluation of the development phase of ergonomic interventions was performed. Interventions under study were carried out by emerging ergonomists (EEs) on their final year-long internship leading to a master’s degree in a University in Canada. For each case, data was collected in real time through a logbook keeping track of every action performed by the EE (type of activity, stakeholder(s) involved, activity duration, goals, results) as well as two semi-structured individual interviews with the EE, following each step of the ergonomic intervention development phase: 1) Request analysis; 2) Analysis of work situations and adoption of an action plan. Semi-structured interviews with key stakeholders (n=4-6 per case) were also performed following step 2.

**RESULTS:** The four ergonomic interventions took place in organizations from different sectors of industry (A: food processing; B: pharmaceutical; C: manufacturing; D: transport). Levers and obstacles to the integration of sex and gender considerations emerged from our results, related to the organization’s context or stakeholders perceptions. For the first step (Request analysis), accident or absence records did not allow a gender-sensitive analysis in any case. Therefore, EEs had to rely on problems and needs mentioned by stakeholders to select work situations requiring analysis and improvements. Stakeholders tend to orient the EEs towards work situations where hazards are most obvious or dramatic, mostly concerning men. For the second step, quantitative data from the logbook show that EEs analyze work situations and compare the work activity of both women and men, when possible. However, when asked to prioritize the possible work modifications emerging from the EEs’ analyses, stakeholders tend to rely on their representations (or views) of the job difficulty, leading to the selection of work modifications mostly concerning

men. The invisibility of musculoskeletal risks in work situations concerning women was yet overcome in one case, as a legal obligation compelled stakeholders towards modifying a work situation which wouldn't have been prioritized otherwise.

**CONCLUSION:** In participatory ergonomic interventions, stakeholders' perceptions related to gender can be obstacles to the adoption of an action plan improving work situations for both women and men, but contextual factors such as a legal obligation may offset some obstacles.

## **[2784] Context of the workplace and positioning of the ergonomist in the consideration of sex/gender in the intervention: a training experience**

Nicole Vézina<sup>1</sup>; Élise Ledoux<sup>1</sup>; Céline Chatigny<sup>2</sup>; Marie Laberge<sup>3</sup>

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**Oral presenter:** Nicole Vézina

Élise Ledoux, Céline Chatigny, Marie Laberge

### **Context of the workplace and positioning of the ergonomist in the consideration of sex/gender in the intervention: a training experience**

How to include in the academic training of ergonomists a concern about the social inequalities related to the characteristics of the people and in particular, sex/gender in the workplace? Professors in ergonomics with students performing an intervention in the workplace and having the concern to take into account sex/gender in these interventions, our reflection led us to several observations. In general, we reflect on the fact that workplace interventions are necessarily modulated by the context of the enterprise, but this should not influence the ergonomist's positioning as a professional whose practice aims the recognition and reduction of work-related constraints as well as the equity.

The analysis of the interventions of our students over several years was done at the level of the types of requests for intervention, the jobs occupied by the people asking for an intervention in ergonomics, the tools present in the companies to make a choice of situations to analyze (for example, different forms of registers) or the tools to analyze workstations (for example, standardized grid) and processes of change established in companies. From these results we drew the need to develop lessons and tools that facilitate the collection of information, the reflective analysis of intervention strategies and the professional positioning of the ergonomist in learning.

For example, requests for intervention from companies often concern handling stations where the weights are important. These positions, whose work is considered heavy, often contrast with positions held by women whose work is considered light. This can be related to the grids used by companies that are not appropriate to highlight the constraints related to these "light" positions.

Thus we can identify different aspects and stages of the intervention where the ergonomist can be vigilant as to the orientations that the intervention will take: elaboration of the portrait of the company, social construction and knowledge of the interlocutors of the company associated with the request of intervention and monitoring, choice of work situations to analyze, method of analysis of work situations, choice of projects, people involved in the implementation of changes (project teams) and evaluation method of the effects of changes.

The company portrait, for example, uses a series of context indicators. Several indicators concern the characteristics of the population and its distribution in the different departments and make it possible to take sex/gender into account (percentage of men and women in the company and in each department, characteristics of positions held by one and the others, etc.).

This communication will use our experiences in supervising these ergonomic interventions, which include sex/gender consideration in a systemic approach.

## [2718] Development of a reflexive learning method aimed at the prevention of occupational injuries of male and female students

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**Introduction:** This communication is based on a study conducted in a classroom of the Quebec Work-Oriented Training Path (WOTP) (Canada). This vocational training path is addressed to students with special needs and aims to prepare them entering the job market. In this training, a particular attention is devoted to occupational health and safety skills development. The study aims to develop a learning and reflexive approach adapted to WOPT population, and gender-conscious oriented, based on making links between work activity, occupational health and safety issues and contextual determinants.

**Methods:** The planned approach is based on autoconfrontation technique (Mollo and Falzon, 2004). This approach has been adapted to WOPT's students who are relatively inexperienced. To do this, we first conducted individual interviews with 20 voluntary students in two classrooms. From this cohort, we recruited six students (3 men and 3 women) who agreed to participate to workplace observations and for who the workplace stakeholders agreed to this procedure. Two women were in typical female occupation (hairdressing salon and childcare center). One man was in typical male occupation (tire installer), one man and one woman were in mix occupation (fast food restaurant) and one man chose a non-traditional occupation (florist). Then, we filmed a complete work shift for each participant. We analysed videos and selected sequence where OHS issues were detected (posture, manual handling, toxic substances). We finally organised autoconfrontation interviews with apprentices. We filmed those interviews and analysed the content in order to highlight population-based and gendered issues to consider in the application of the technique.

**Findings:** In the recruitment process, we noted that the observation procedure needed to set autoconfrontation interviews is not accepted everywhere. When clients are involved, it may represent challenge to convince workplaces (more often for women typical jobs?), and so when obvious safety hazards are present (more often for men typical jobs?). Results highlight differences between men and women in the choice of the place of internship, apprenticeship conditions, work relationships (supervisors, colleagues), work conditions (awkward posture, task, hazards...), and even in the exploitation of the autoconfrontation method.

**Conclusion:** To our knowledge, autoconfrontation technique has been relatively unexploited for young workers with short experience and low literacy about work. This approach is worthwhile with WOTP's students because it allows to access visible aspects of activity (e.g. working methods, actions or postures) and so subjective and less visible aspects of work activity (e.g. strategies, motivations, reasoning, perception). Conclusions of this study suggest adjusting reflexive methods of learning used in training according to the characteristics of apprentices, internship characteristics, and to gender specific considerations.



## [2725] Photography diagnosis and risk exposure for women and men

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This communication is based on a research action in a major French logistics company with the backing of the French National Agency for the Improvement of Working Conditions. The Company called on us for a constant high absenteeism's gap between men and women. In this company, there is a professional equality's policy; employees have similar careers except for the glass ceiling of senior positions of responsibility. This research took place with three establishments of approximately two hundred persons. In all of their establishments, after a health and safety committees to present the project, a working group was created with executive, prevention managers, occupational health doctor and unions.

To understand this absenteeism's gap, we used, among other things, a photography diagnosis to highlight exposures that women may face in a same job tittle. Photography diagnosis allows verbalizing via picture, objects, materials or work situations which are resources or constraints for employee in their work activity. The directive given to the working group is "you need to realize two or three photos of what for you in the working activity of the women can be a resource (help the work) or a constraint (which can generate of the hardness, wear or dissatisfaction)." Photos are made by the members of the working group then presented by each member and discussed. The other members of group could express themselves on photos and share their real-life experience. Photography diagnosis allows the researcher to understand real work to take into account the views of the employee.

Analyse of work situation about women and men through photos looked to highlight exposures that women may face in a same manual work. Women are exposed to an insufficient consideration of biological difference between men and women (size, muscular strength); working materials conceived on male norms aren't adapted to women and daily high physical demands About ten photos concerned equipment and handling assistance. On these photos, the postures adopted by the agents highlighted insufficient adaptation of equipment for the agents of small and big sizes. Some photos highlight the repetitive movements, the employees are supposed to carry out up to one thousand five hundred times the same movement per hour.

Photography diagnosis allowed the employees to express themselves on their work and discuss health preservation strategies. Photography diagnosis is interesting because it promotes reflections and exchanges of job perception between the members of the working groups. The consideration of the difference of sex and gender allowed to highlight and to reveal new elements. Thanks to photography diagnosis, women they have expressed their difficulties at work. Photography diagnosis is also a pedagogical interest because it allows company actors to be aware of problems, to confront difficulties and think solutions.



## [1247] COGNITIVE ERGONOMICS IN ARCHITECTURE: CREATIVITY AND AMBIENCE IN CHILDREN'S HEALTHCARE SPACES

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Childhood diseases make patients' lives go through a rapid and intense transformation. It breaks the line of continuity in their natural development with an unexpected sense of danger. This happens despite a child's age or cognitive capacity to understand the reality that surrounds them.

Although the built environment cannot eliminate patients' suffering, it can contribute to improve their well-being. The discussion of humanization of architecture seeks to translate in a practical way the idea of paradigmatic revisions of healthcare practices happening today.

The concept of hospital environment based on the precepts of cognitive ergonomics expands the understanding of hospital ecology. It encompasses the dimensions of relationships, the physical structure, and the way these two interact with the activities that occur there. Ambiance then becomes an important factor in breaking preconceived ideas of what healthcare spaces should look like.

Elements of the built environment may act as modifying and qualifying factors of the space. They can stimulate a positive perception of the environment in which people inhabit. This contributes to the construction of new situations that may come to transform paradigms of healthcare spaces.

Architecture is, then, a facilitating tool for the change of the work process. A healthy environment creates healthy employees, the more frequent occupants. As a result, there is improvement in the interaction they have with patients. This shows that both Ergonomics of the built environment and Ergonomics in the design process play a relevant part in the betterment of children's healthcare spaces.

As such, the goal here is to understand the relationship between users and the environment, assessing whether the needs of children and their caregivers are met. The goal is their well-being, adequacy of physical elements, and good usability of the space. This paper aims to discuss conceptually the use of cognitive ergonomics as a tool of inter and transdisciplinarity in the design process of the built environment of children's healthcare spaces. It seeks to understand how the integral needs of the users may become the focus – to the detriment of the disease-centered approach –, with more humanized spaces adapted to their expectations and needs.

This paper brings a study on the conceptual aspect of ergonomics and its benefits to the built environment. To obtain the necessary references to the understanding of the theme, this article was based on a bibliographical research of consecrated authors that deal with the subject in question. The conclusion is that Ergonomics of the built environment contribute significantly to the day-to-day process of a hospital space.



## **[2032] What place and role of observation in ergonomics approaches?**

Boccaro Vincent<sup>1</sup>; Zara-Meylan Valerie<sup>2</sup>; Delgoulet Catherine<sup>3</sup>; Gaillard Irène<sup>4</sup>; Barthe Béatrice<sup>5</sup>

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### **Symposium “Observations in actual work situations : Is this method still a key part of ergonomics practices?”**

#### **Introduction**

In the activity oriented perspective of ergonomics, observation method is historic, as a significant part of the identity. It plays an absolutely central role in the holistic approach of work activity (Guérin et al., 2007). Nevertheless, work has changed: it is more and more digital, more and more collaborative, more and more changeable, more and more here and elsewhere. In this perspective, this communication aims to propose a picture of the uses of observation and the “traditional” but also new role(s) of observation methods in ergonomics approaches today in France and in others countries.

#### **Objectives and future developments**

Several pieces of ergonomic research show how relevant and effective observation is for both research work and consultancies (for example: Gaudart, 2000; Eklund et al., 2009; Engkvist et al., 2009; Boccaro et al., 2014). It complements others methods and it contributes significantly to ensure analysis quality and relevance. For example in France, participative method, focus group, confrontation interview or dialog group are more and more use by ergonomists to analyze and transform work situations or to design them. In the same time, tools for observation disappeared and others are designing in relation with researcher and practitioner (e.g. Actograph project, Barthe et al., 2017).

In this perspective, our contribution will be twofold in the symposium. First, we are conducting an worldwide survey to identify the panel observation tools (to search and intervene) and to better know uses of observation methods in ergonomics and by ergonomists. The assumption is: this survey is a mean of an understanding the creativity in practice in our own discipline and profession. Results will be exposed in the final version. In a second part, our contribution aims to define how a new tool dedicated to the observation processes in ergonomics (ActoGraph) encounters for ergonomists’ needs identified previously and how it is relevant to the variety of uses.

## **[2176] Medical device design: What works best when it comes to integrating Human Factors and Ergonomics?**

Chris Vincent<sup>1</sup>

<sup>1</sup>*PDD Group Ltd., London, United Kingdom*

For Symposium: Applying human factors to medical device design

The design of consumer products often ignores the requirements of the mild to moderately impaired, failing to match the design of products, environments and processes to the known perceptual, cognitive and movement capability ranges of people. In this case both the safety and usability of the product can be impacted. Avoiding this mismatch is very important for medical devices. We need to optimise properties relating to Human Factors and Ergonomics during the design process. Indeed, medical devices are subject to design controls and prescribed engineering process including the application of knowledge about human factors / human capabilities (physical, sensory, emotional, and intellectual). Taking the design and manufacture of such equipment as an example, design is a complex and specialist effort involving multiple stakeholders and trade-offs. Balancing competing objectives requires an extensive dialogue and collaboration across multiple entities. It is difficult (if not impossible) for any single person to have a full understanding of the design process and there are many ways to convey people related requirements. Finding the right tool for the job and allowing for such information to be shared is in the interests of a cross section of stakeholders accountable for safety, usability and efficiency. This session will review multiple approaches to integrating Human Factors and Ergonomics. We will consider what works best in practice. For example, what are the types of approach that allow for effective collaboration and resolution of multiple competing objectives. We will provide a comparison of the different ways in which user requirements can be gathered, specified and reconciled. We will consider what works best when it comes to providing input during medical device design.

## **[2274] How does the seat cover influences the seat comfort evaluation?**

Maximilian Wegner<sup>1,2</sup>; Shabila Anjani<sup>1</sup>; Wenhua Li<sup>1</sup>; Peter Vink<sup>1</sup>

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Sitting in a seat deforms the human body with its skin and tissue as well as the various layers of a seat. The interaction between human and seat depends on the seat properties but also on the individual occupant sitting in the seat resulting in a balance of force. The foam and the seat cover are components with a significant influence on the seat characteristics and the seat comfort evaluation. Whereby the most seat comfort studies focus on foam characteristics (*Ebe and Griffin, 2000* and *Ebe and Griffin, 2001*) and the shape of the seat (*Kamp, 2012* and *Kolich, 2003*). There is no existing study which considers the influence of the cover on the perceived seat comfort, even though it is the top seat layer interacting with the human body. It is assumed that the seat comfort is influenced by foam and seat cover material initiating pressure and stretch of the skin while the human stresses the seat.

Thirty subjects of different statures participated in this study comparing two seats in various positions. All components and component properties were identical for both seats, except for the seat cover which was leather in one seat and fabric in the other seat. The participants were not informed about the differences of both seats. The seats had to be assessed in various positions focusing on the interaction between human and seat while excluding the visual and thermal factor by blind-folding the participants and tempering the seats. The participants were guided by an assistant in order to ensure the reproducible sitting procedure and to prevent touching the seats by hand.

The objective of this study is to investigate the influence of the seat cover on the subjective seat comfort evaluation. It shows how the cover properties affect the workspace of foam, the resulting interaction between human and seat and the seat characterization. Further studies will be done investigating a wider range of cover materials and other combinations of different seat components. The influence of the seat cover on the seat comfort should be defined relatively to the foam and other seat components.

## **[3265] Lessons learned by the Human Factors in Safety Program from Singapore**

Chui Yoon Ping<sup>1</sup>

<sup>1</sup>*Singapore University of Social Sciences, Singapore, Singapore*

Title:

**Lessons learned by the Human Factors in Safety Program from Singapore**

Presenter:

**Associate Professor Chui Yoon Ping**, Head of Programme (Human Factors in Safety), Singapore University of Social Sciences.

### **Abstract**

Human Factors is not a widely known discipline in Singapore – Ergonomics is often confused with economics and human factors with human resources. The BSc. Human Factors in Safety program was the first of its kind in Singapore and was launched in July 2010. The program was structured such that students are equipped with key human factors / ergonomics fundamentals and knowledge in designing efficient man-machine-workplace- environment systems. The program also incorporates key competency modules according to a Workplace Safety and Health Workforce Skills Qualification (WSH WSQ) framework that was developed by the Workforce Development Agency (WDA), a statutory board under the Singapore's Ministry of Manpower. This was done so that the programme could be recognised by MOM for graduates to register as Workplace Safety and Health Officer upon graduation. . The Ministry of Manpower has, over the years, increasingly emphasized the importance of human factors in the effort of improving workplace safety and health. Hence, this has raised the awareness and needs of human factors training. By working closer with the ministry, we have established an important niche of being the university of choice to provide human factors training especially in Workplace Safety and Health. The program was also developed for adult learners, students who are currently working on a full-time basis and pursuing a degree program on a part-time basis and this poses a unique set of challenges in providing a comprehensive degree programme with a reduced face-to-face interaction. The presenter, who is currently the Head of Program, will share on the lessons learnt in the development, implementation and operationalisation of a degree programme in a discipline that is not very widely known, one that is a combination of human factors and WSH disciplines and one that is aimed towards working adults. Lack of human factors awareness and strong industry support are the biggest threats to the programme. However, the enduring vision of training a new generation of Singaporean equipped with human factors knowledge is the motivating force to overcoming all the challenges faced to ensure the success of the programme.



