Adopting occupational exoskeletons: from initial interaction to long-term use

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Prevention and musculoskeletal disorders (MSDs)

Musculoskeletal disorders are Europe’s most common occupational disease

When all the solutions to improve working conditions have been tested without success, or when automation is not feasible

Need for assistance and mobility !

Exoskeleton as a solution for preventing MSDs ?

Context

Consensus on the benefits of exoskeletons but not systematically adopted in workplace

Understanding and formalizing the cognitive and psychosocial mechanisms of adoption

Quality of the integration & the Human Exoskeletons interactions (HEI)

Degraded HEI ➔ psychosocial risk factors, musculoskeletal disorders, and accident risks

Overview of INRS research conducted in companies & lab (2019 – 2025)

Adoption process

Pre-adoption → **Familiarisation** → **Routinisation**

Operators form their attitude before use based on their mental image of the device and its functioning

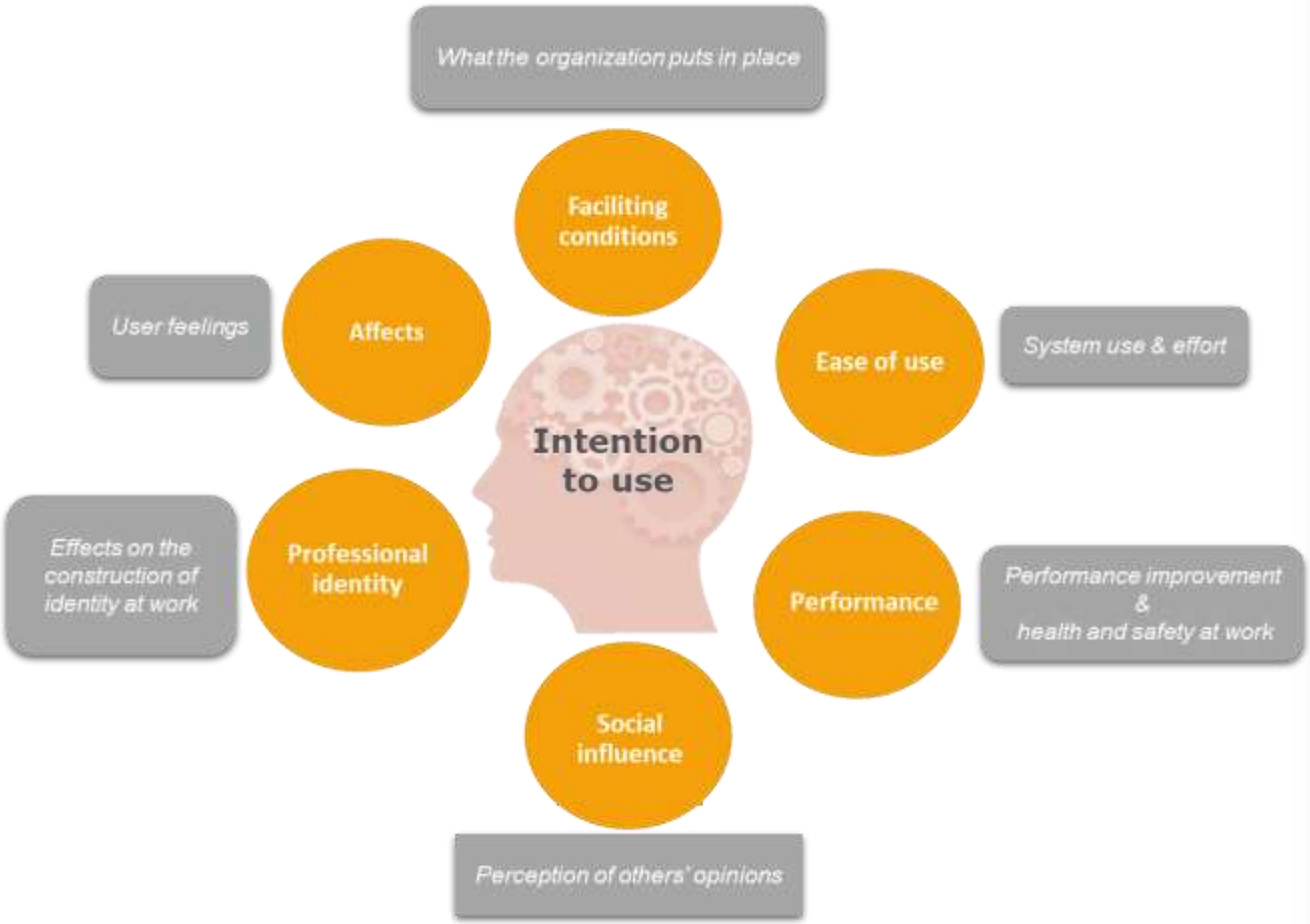
Initial phase of interaction where the user learns to operate the technology

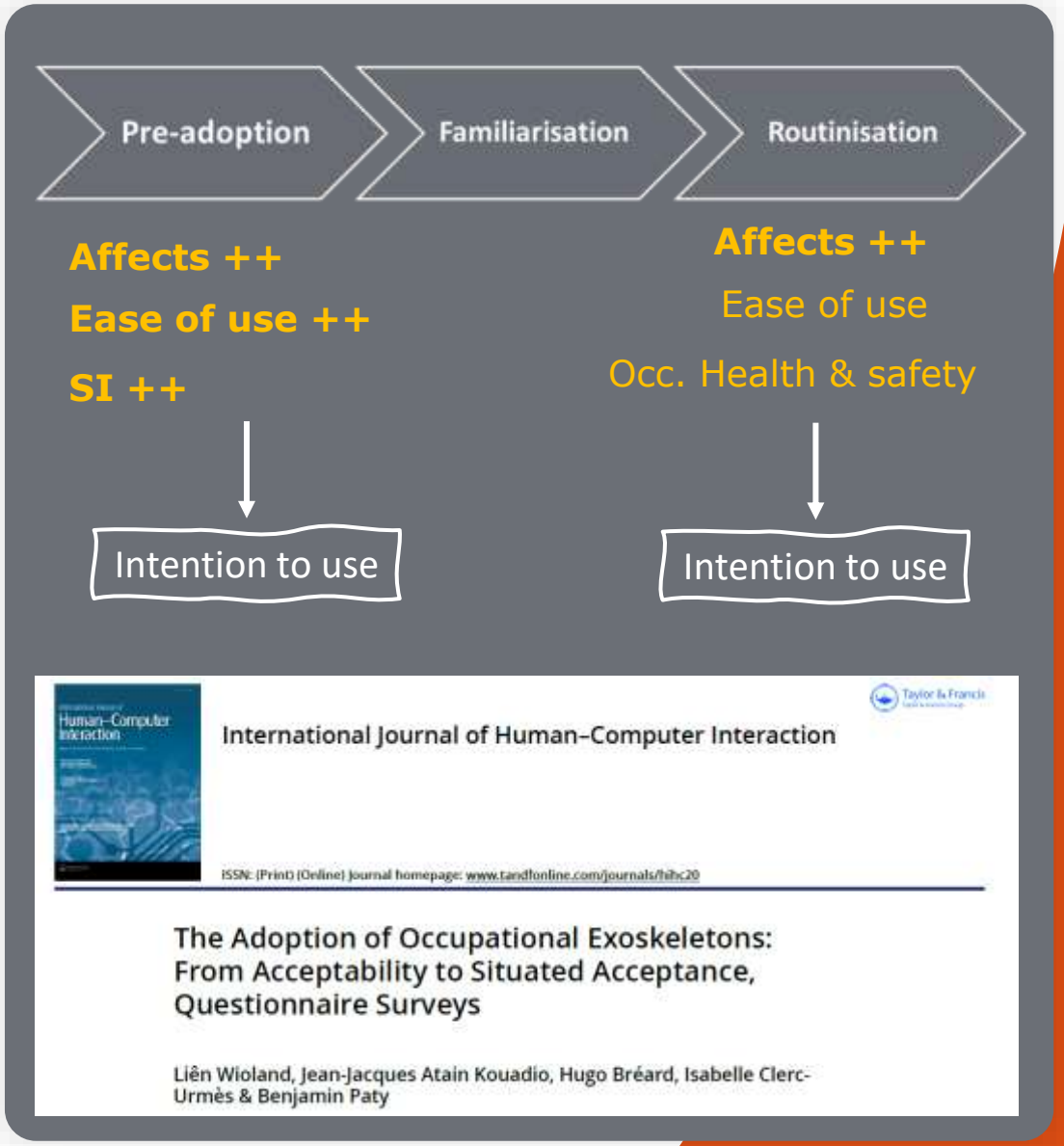
Period when technology use becomes a habitual routine

Adoption : *intention to use*

- Influenced by several *determinants* and by the *user–exoskeleton interaction experience*
- At each stage, users evaluate the balance of pros and cons to decide whether to continue or stop the adoption process
- Adoption trajectories differ among users

Determinants





User–exos interaction experience

Pre-adoption

Even before interacting with the exo, future users form an opinion based on their **expectations** and the six key **determinants**, which influence their intention to try the device

Familiarisation

Discovery of the device's side effects

Confrontation with the **expectations** defined during pre-adoption

Adaptation : continuous testing and adjustments to maximize the device's potential

Reevaluations several times during this period

Six key **determinants**

Unstable evaluations (varied trajectories)

Duration varies depending on users and complexity of adjustments

Routinisation

Explorations : long term users explore the device's use in unexpected situations, customizing it to their needs and thus expanding its range of applications

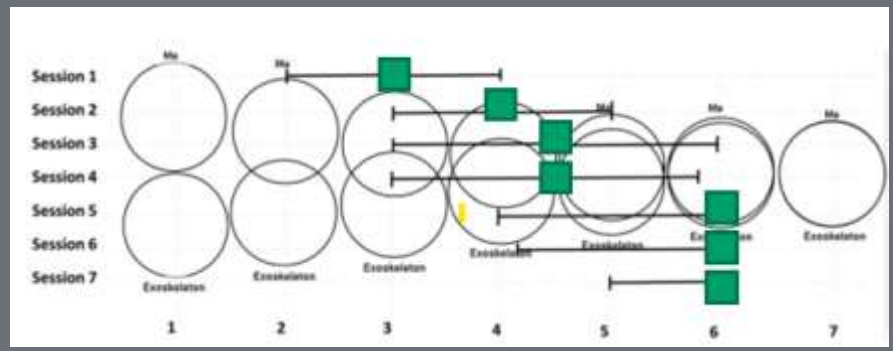
The intention to continue using a technology depends on user **satisfaction**, determined by the net benefits of the device and whether it continues to meet the **user's expectations (new determinant)**

Stabilization appropriation

In parallel

Pre-adoption → Familiarisation → Routinisation

Embodiment : integration of the exo into the body representation strengthens *(green square)* throughout the process
-Long-term users feel *as if they are one with the exo* *(orange square)*



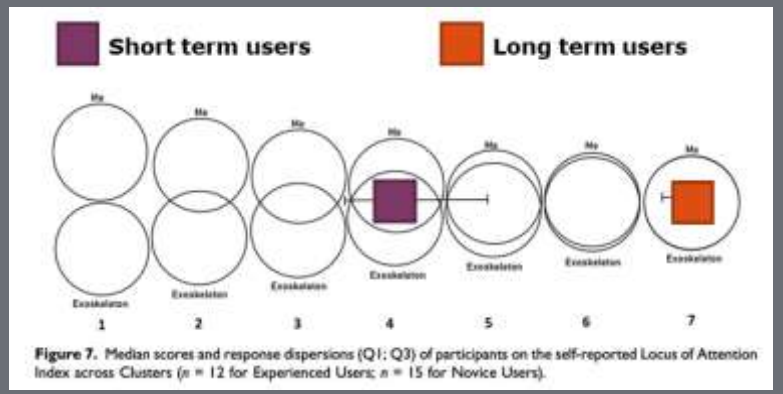


Figure 7. Median scores and response dispersions (Q1; Q3) of participants on the self-reported Locus of Attention Index across Clusters (n = 12 for Experienced Users; n = 15 for Novice Users).

Pre-adoption → Familiarisation → Routinisation

The **collective** has a crucial impact throughout the process (especially during pre adoption and familiarization)

-Negative influences include mockery, negative looks, and exclusion from the group

-Positive influences include collective intelligence, co-creating solutions to overcome side effects, sharing adaptations and explorations

Key points to remember

Adopting occupational exoskeletons is a complex, dynamic and long-term process (**3** stages : pre-adoption, **familiarization**, routinization)

It depends on :

The **evaluation of determinants**

The evaluation of the user–exos interaction experience

-The success of the mutual adaptations (the user adapts the technology to their needs while simultaneously adjusting to its constraints, in a process of dynamic appropriation)

Workplace environment

➔Different adoption **trajectories**

Key determinants

Faciliting conditions, ease of use, performance, social influence, professional identity, affects, expections, satisfaction, collective

Quality of the user-exos experience (adaptations / appropriation, explorations, embodiment)

These elements provide new reference points that enrich the approach to integrating exoskeletons and specify actions to be implemented for **occupational risk prevention**

Prevention

Structure the Exoskeleton Integration Process

From the definition of the needs of physical assistance to the follow-up of the integration

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lications

Provide prevention actors with the necessary tools

An operational support designed for prevention professionals that assists companies in integrating exoskeletons as a solution to occupational health issues (2026)

Work in progress

Thank you for your attention

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