Fire and Evacuation Modelling Technical Conference 2022
Hybrid In-Person and Online Event, September 12-14, 2022

Evacuation of People with Functional Limitations: Research Knowledge, Gaps and Modelling Implications

Enrico Ronchi[1], Erik Smedberg[1], Björn Slaug[2], Gunilla Carlsson[2], Giedre Gefenaite[2], Steven M. Schmidt[2]

Department of Fire Safety Engineering,

Department of Health Science

Lund University, Sweden

enrico.ronchi@brand.lth.se

Acknowledgements

- Project sponsor is the Swedish Research Council for Sustainable Development

FORMAS

- This presentation is based on the PhD project of Erik Smedberg
- O. Bukvic and L. Norin (help with literature reviews)

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Multi-disciplinary team

Collective effort by project team (FSE + Health Science) → Centre for Ageing and Supportive Environments (CASE) www.case.lu.se/en/

Fire Safety
Enrico Ronchi,
Erik Smedberg

Psychology
Steven Schmidt

Occupational therapy
Gunilla Carlsson

Public Health
Björn Slaug

Gerontology
Giedre Gefenaite

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Outline

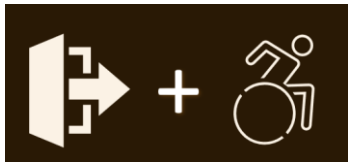
- Functional limitations and evacuation performance
- Perspectives on egressibility
- The Egress Enabler
- Gaps and evacuation modelling implications

Functional limitations and evacuation performance

- Prevalence of functional limitations increasing (ageing population)
- Accessibility is increasing

EGRESSIBILITY

Accessibility to means of evacuation



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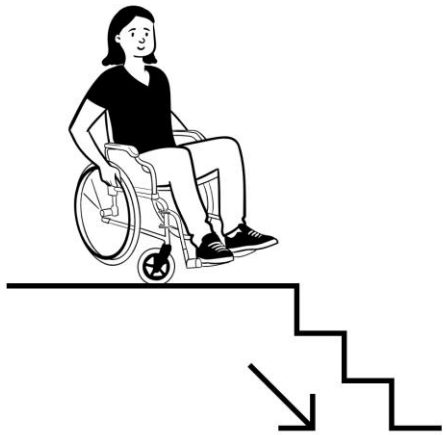
Functional limitations and evacuation performance

Functional limitation = Restriction in performance

Models of disability

"Her **impairment** is the problem! Rehabilitation is needed so she can walk"."

Medical Model



"The **stairs** are the problem! There should be a ramp."

Social Model

"She has an impairment and is restricted in walking in stairs. A holistic approach is needed to support her mobility"

Biopsychosocial Model

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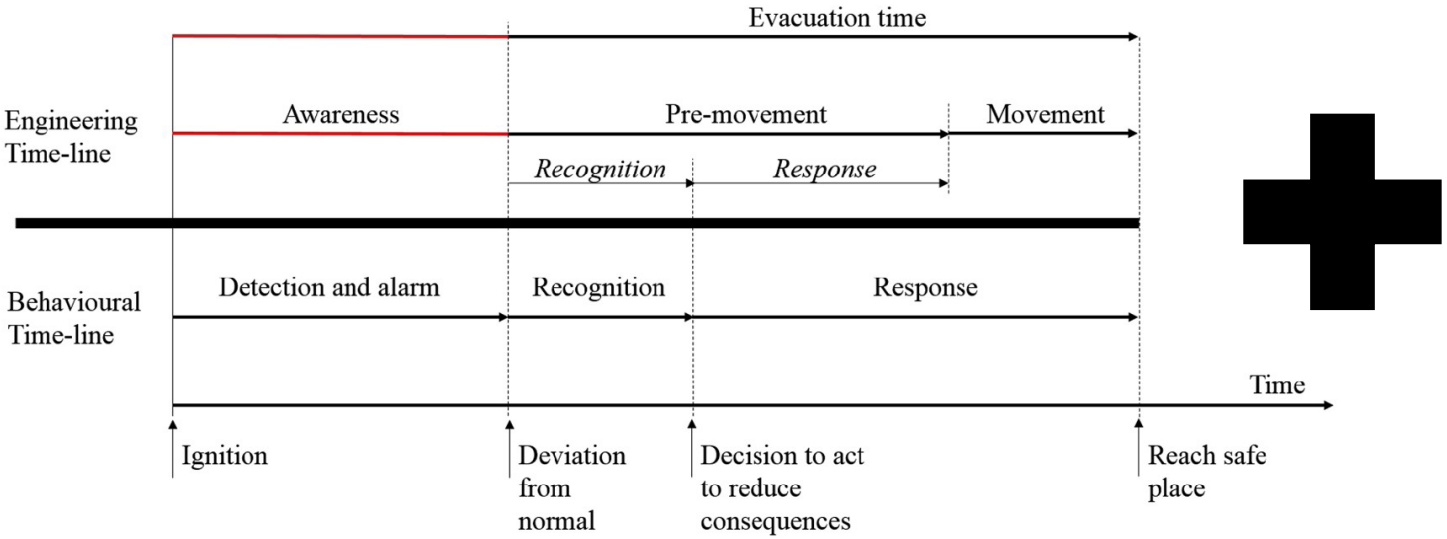
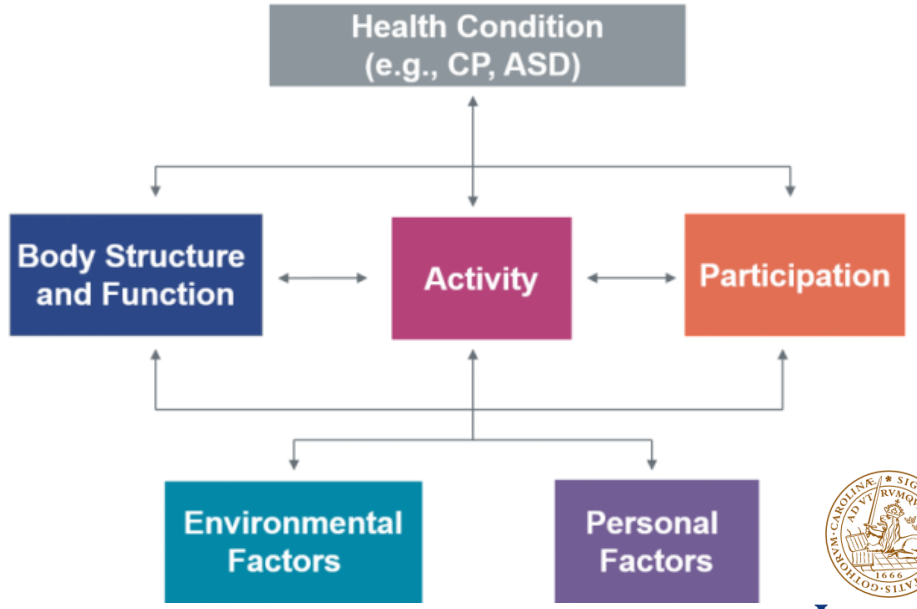
Functional limitations and evacuation performance

Literature review on evacuation of people with functional limitations (and related accessibility research)

Evacuation timeline



International Classification of Functioning, Disability and Health (ICF)



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Functional limitations and evacuation performance

Coupling functioning according to ICF with evacuation activities

Table 1
Evacuation activities linked to ICF classification and functional limitations with listed references

Evacuation activity [phase][a]	Predominant activity in terms of ICF—block	Predominant activity in terms of ICF—category	Visual limitation	Hearing limitation	Mobility limitation	Upper extremities limitation	Cognitive limitation	Other functional limitations[b]
Hearing alarm [A,P]	Purposeful sensory experiences	Listening		[27, 31, 43, 53]				
Smelling emergency cues [A,P]	Purposeful sensory experiences	Other purposeful sensing[c]						Research gap[d]
Seeing emergency cues [A,P]	Purposeful sensory experiences	Watching	[34]					

Systematic categorization of functional limitations in the evacuation context

O. Bukvic, G. Carlsson, G. Gefenaite, B. Slaug, S. M. Schmidt, and E. Ronchi, "A review on the role of functional limitations on evacuation performance using the International Classification of Functioning, Disability and Health," Fire Technol, Sep. 2020, doi: 10.1007/s10694-020-01034-5.

Perspectives on egressibility

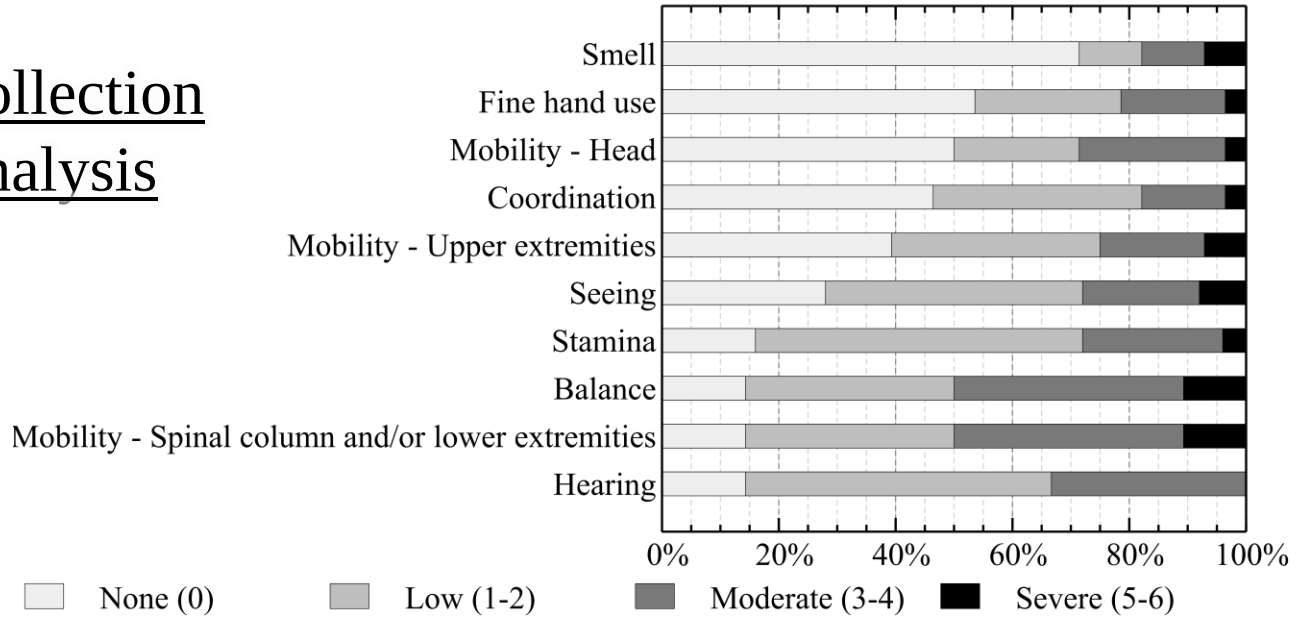
Qualitative study *to investigate the subjective perspectives on egressibility of older people with functional limitations, including person-environment interactions and strategies to mitigate issues*

Semi-structured interviews for data collection
Reflexive thematic analysis for data analysis

28 participants

Diversity in functional limitations

Age 61-88



THREE THEMES IDENTIFIED

Smedberg, E., Carlsson, G., Gefenaite, G., Slaug, B., Schmidt, S. M., & Ronchi, E. (2022). Perspectives on egressibility of older people with functional limitations. *Fire Safety Journal*, *127*, 103509. https://doi.org/10.1016/j.firesaf.2021.103509

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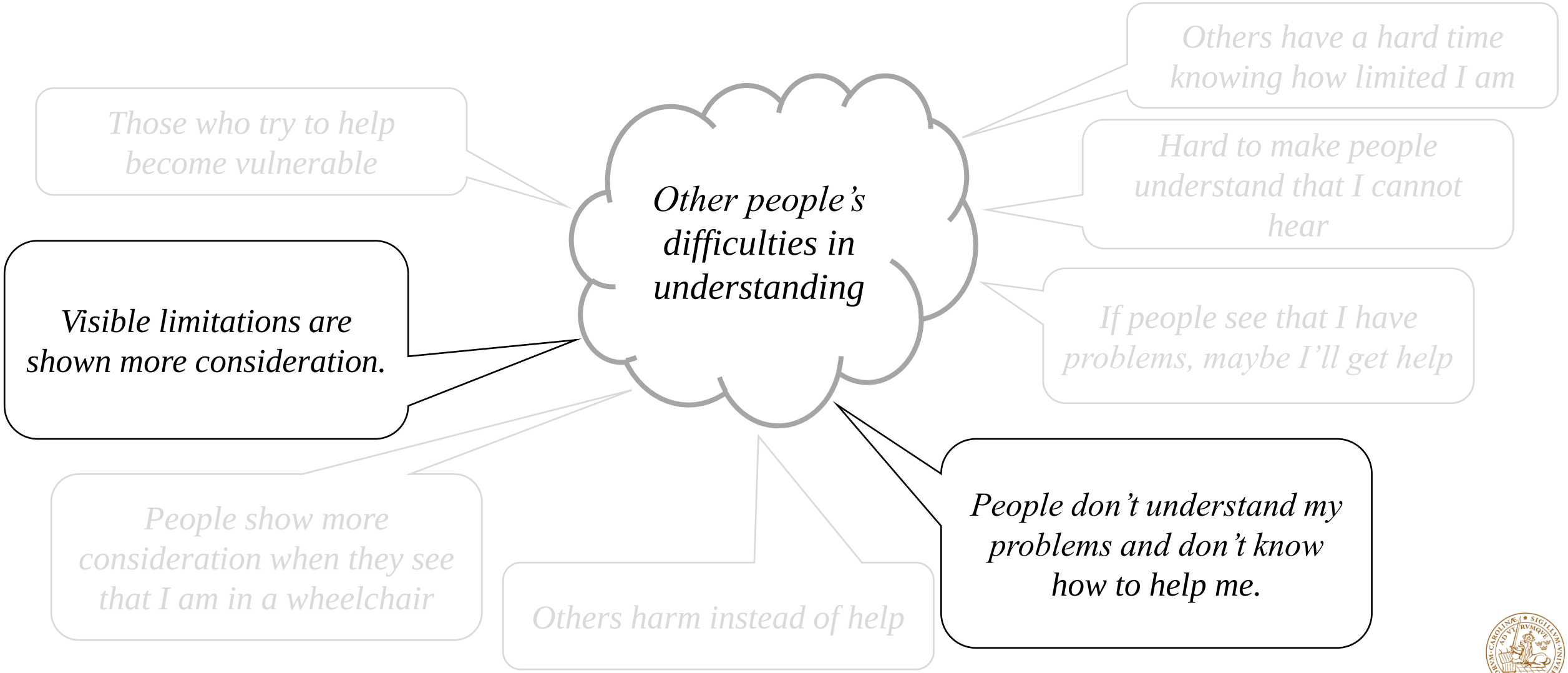
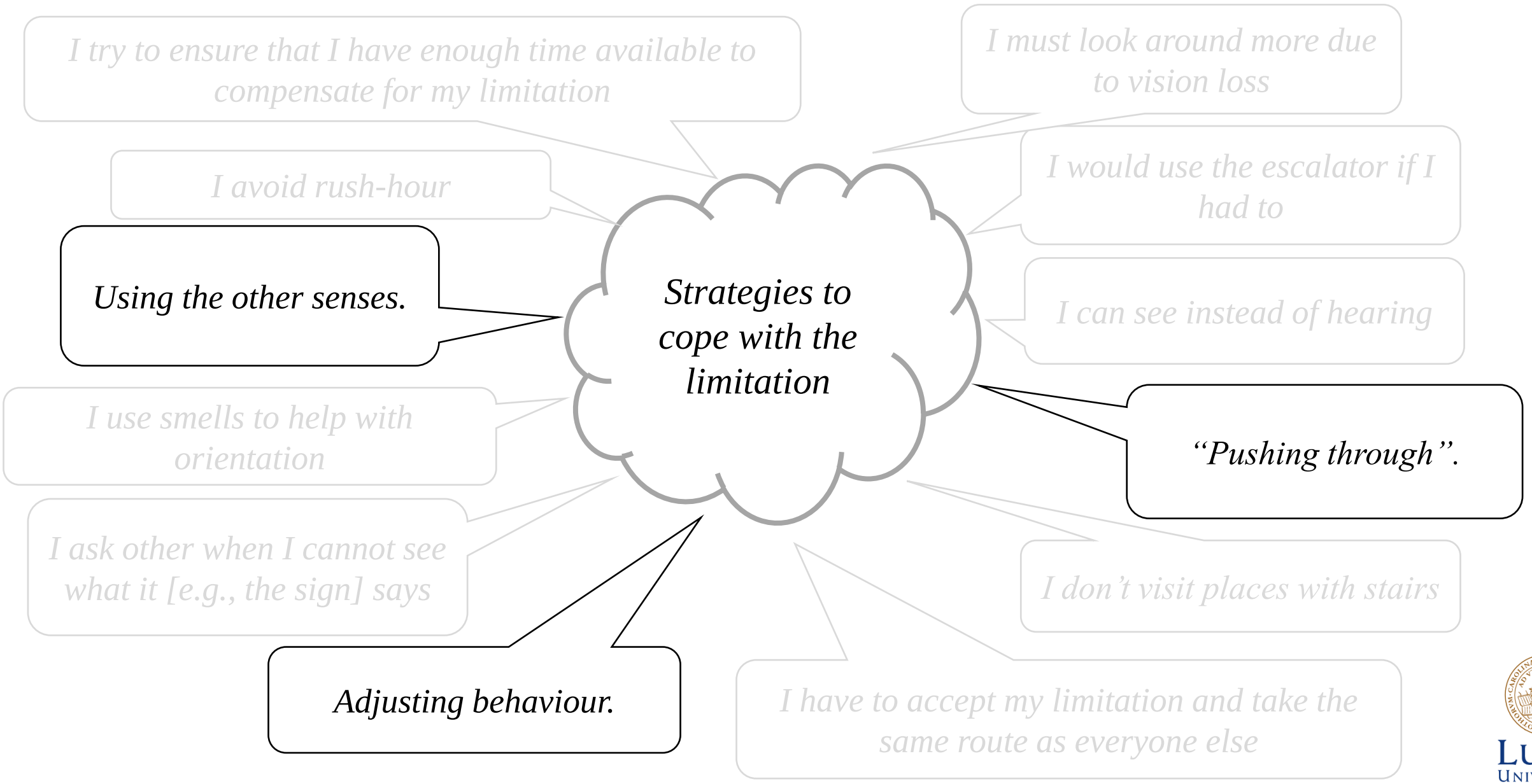
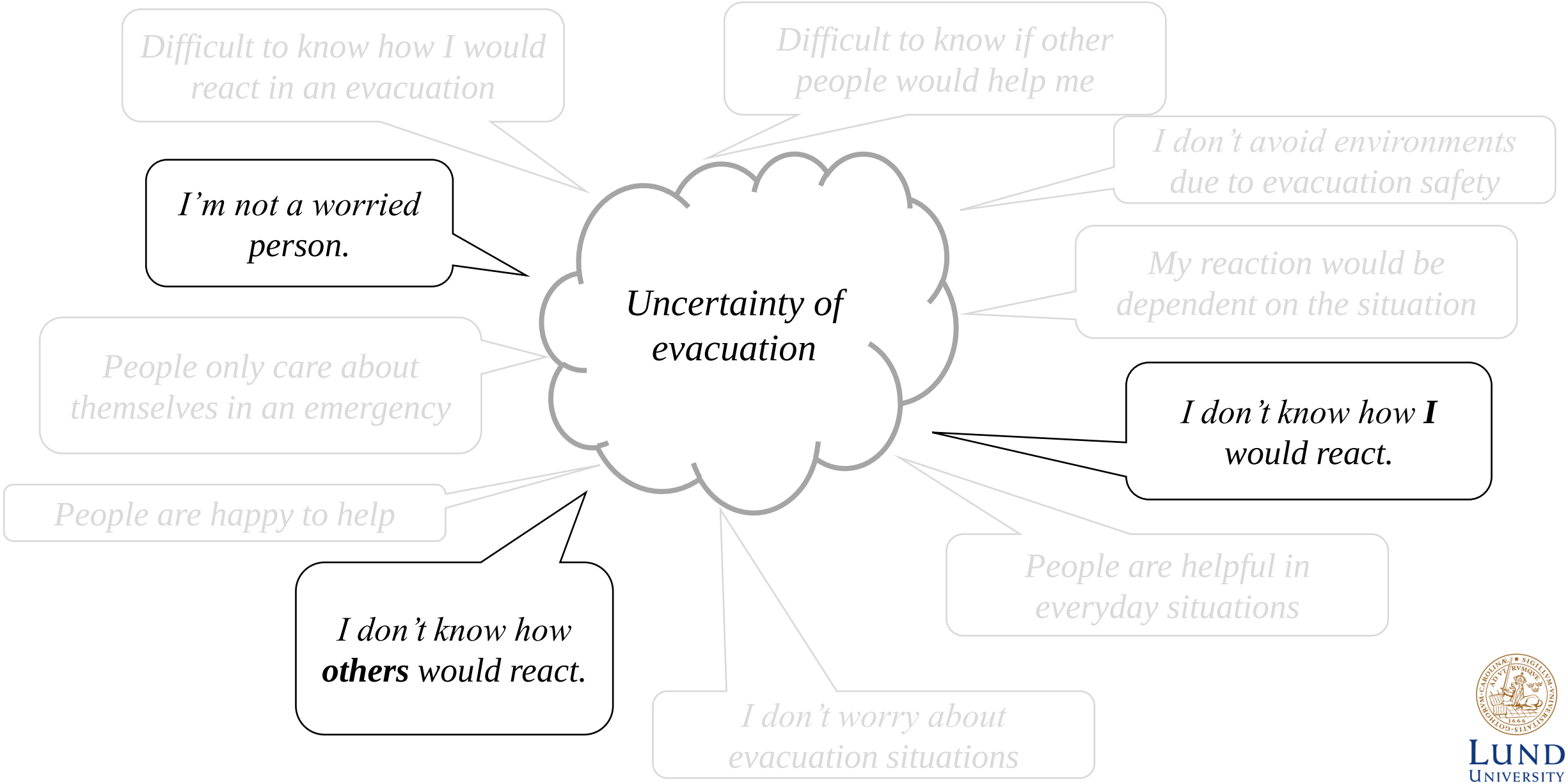
Perspectives on egressibility



Perspectives on egressibility



Perspectives on egressibility



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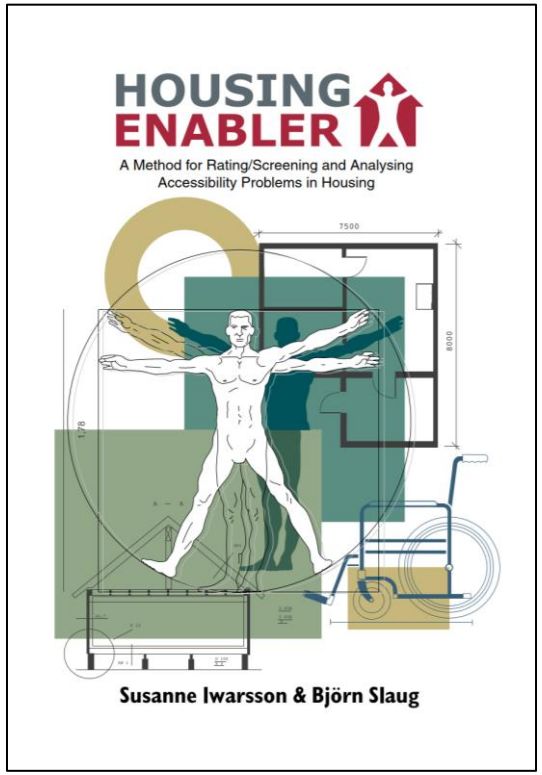
The Egress Enabler

- An assessment instrument (in a simple spreadsheet format) for egressibility in public buildings
- Based on the Housing Enabler, an accessibility instrument with 20+ years of development and application
- Accessibility is seen as a measurable entity
- Tested for reliability and validity



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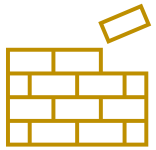
The Egress Enabler

It mirrors the approach of the Housing Enabler

A personal component

Presence of functional limitations (binary variables)



An environmental component

Presence of environmental barriers through checklist items (binary variables)

The analysis

Severity estimates from co-existence of environmental barriers and functional limitations (numerical variables)

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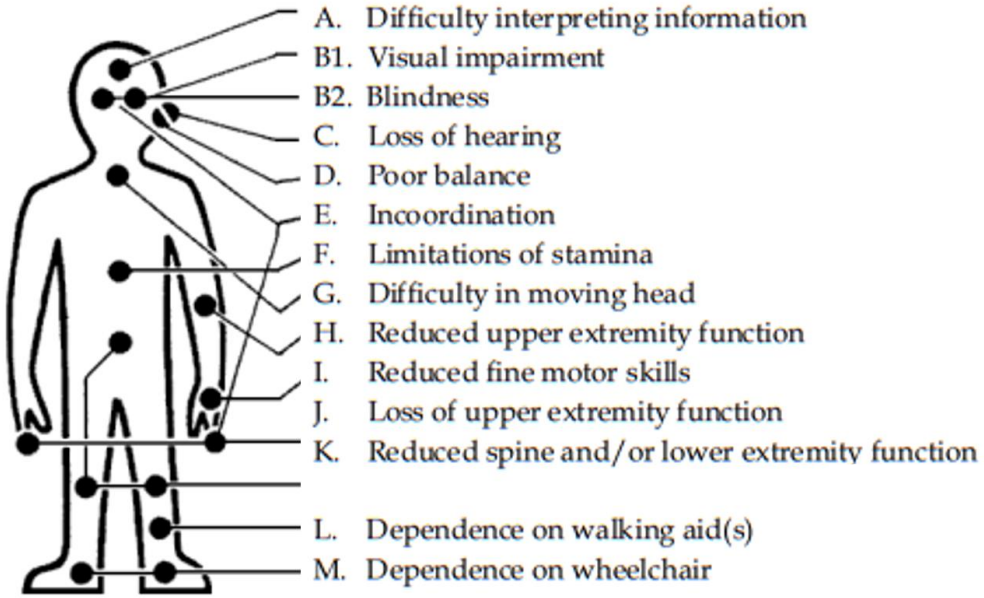
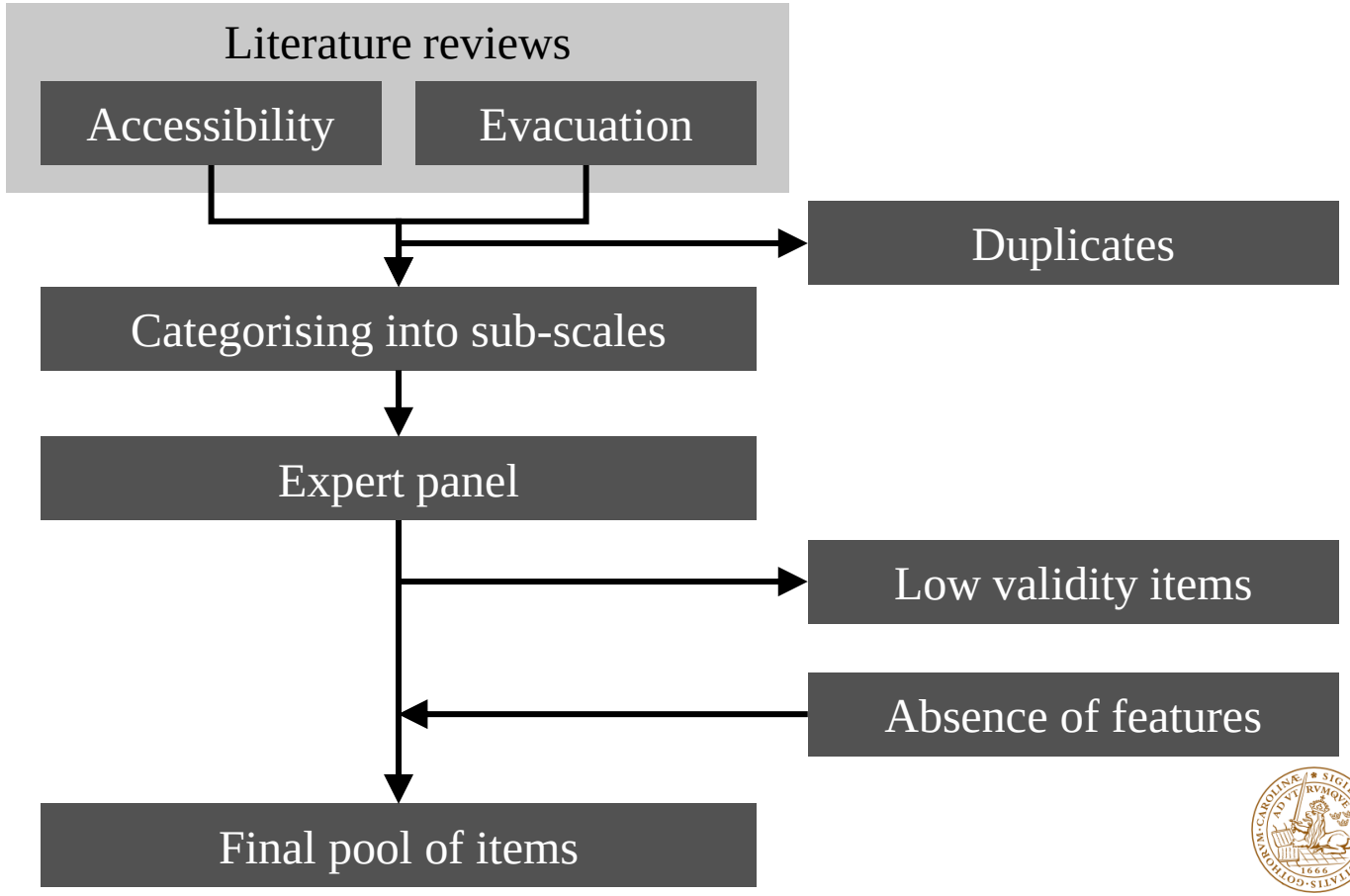
The Egress Enabler

Personal component



Environmental component



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The Egress Enabler

The analysis: Score system

Comparing environmental features for different people

Environmental component | Personal component

	Yes	No	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M
Is the evacuation path free from obstructions?		x	0	2	3	0	1	1	0	0	0	0	0	0	2	3

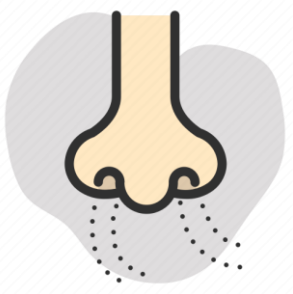
Severity scores

Gaps and evacuation modelling implications

Main research gaps

Cognitive limitations

Difficult to collect data due to ethical issues



Smell

No research on ability to smell smoke!

Upper/lower extremities

Most research is about lower mobility, need to study upper extremities

Temporal dimension

Accessibility does not look at ”how long it takes”

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Gaps and evacuation modelling implications

Need for a **paradigm shift** in FSE → Need to make use of research in the Health Science domain!

Foundation for a **new stream** of research → Egressibility

Need for more **empirical studies** on functional limitations vs evacuation

Our work is based on the concept of **equal** rights to safety

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Gaps and evacuation modelling implications

Lack of resolution in **personal component** → Risk for oversimplification of functional limitations in modelling applications (looking mostly at mobility limitations)

Lack of data → Hard to model certain type of limitations, since limited or no empirical research is available (e.g., cognitive limitations, smell, speech, hearing limitations, visual limitations, upper extremity)

Evacuation model **developments** → Interaction between given occupant profiles and environment could be improved (i.e., environmental features directly affecting behaviours)

Evacuation model **developments** → Lack of **environmental features** → Most environments consider only static features of the building explicitly

Evacuation model **calibration** → In absence of data and explicit modelling features, need for flexible models for case-to-case input calibrations

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Contacts

Enrico Ronchi

Enrico.ronchi@brand.lth.se
Twitter: @Enrico_evac

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References

Bukvic, O., Carlsson, G., Gefenaite, G., Slaug, B., Schmidt, S. M., & Ronchi, E. (2020). A review on the role of functional limitations on evacuation performance using the International Classification of Functioning, Disability and Health. Fire Technology. https://doi.org/10.1007/s10694-020-01034-5

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