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Postprint

This is the accepted version of a paper presented at *Centre for the Advancement of University Teaching, one day online conference 28th May 2020*.

Citation for the original published paper:

Airey, J. (2020)

Physics Education Research

In: Stockholm University

N.B. When citing this work, cite the original published paper.

Permanent link to this version:

<http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-411274>

Fysikensdidaktik

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Physics Education Research

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Department of Mathematics and Science Education



- 120 employees
- Most work with teacher training
- Full spectrum pre-school to university-level
- Unique in Sweden
- Science faculty

- 1. A short history of Physics Education Research.**
- 2. The research I do.**
- 3. University pedagogy, University didactics, or something else?**

Discipline-based education research

“investigates learning and teaching in a discipline using a range of methods with deep grounding in the discipline’s priorities, worldview, knowledge and practices”.

Long-term goal: *“to understand the nature of expertise in a discipline”.*

US National Research Council (2012, p 9)

A history of physics education research (PER)

PER is discipline-based.

Started in the US in the late 50s.

Had one single contributing factor...

Sputnik

Signalled the start of the “space race”.

America needed physicists quickly.

Lots of money was fed into physics education.

Attracted academics who would not normally have been interested in education.

History of PER

Focussed on student problems with physics.

Empirically tested different ways to overcome these problems.

More interested in what worked than why.

If the students could solve physics problems then they understood the physics, right?

History of PER

Well actually, no...

Found that students could now solve the physics problems, but they **didn't really understand physics.**

History of PER

Misconceptions

Students were found to have **similar, incorrect ideas** about physics

Led to research on:

Conceptual change

Diagnostic concept inventories

E.g. The force concept inventory

Hestenes et al (1992)

The force concept inventory

A bowling ball accidentally falls out of the cargo bay of an airliner as it flies along in a horizontal direction. As observed by a person standing on the ground and viewing the plane as in the figure below, which path would the bowling ball most closely follow after leaving the airplane?

The force concept inventory

Spawned a large number of different concept inventories. (I've even been involved with one!)

Hill et al (2014)

Led to a focus on conceptual understanding rather than problem-solving ability

Recent work (last 20 years)

Growing interest in students' attitudes to science.

Work on identity "becoming a physicist".

Focus on inclusiveness for different groups.

Mainstream still deals with student understanding of different areas of physics.

My research in PER

In my work I'm interested in **physics knowledge** and **how it is represented**. Airey (2006, 2009)

Graphs, diagrams, mathematics, language, etc.

Interested in how these resources work both **alone and together** to make "physics".

If we understand this relationship, then we can begin to understand how to teach our students.

My research in PER

My work starts empirically but always tries to scale up to theoretical mechanisms.

Always have recommendations for teaching.

An example:

Two theoretical terms derived from my work:

Disciplinary affordance

The **agreed meaning making functions** that a resource fulfils for a particular disciplinary community.

Airey (2015)

Pedagogical affordance

Definition:

*The **aptness** of a resource for teaching some particular educational content*

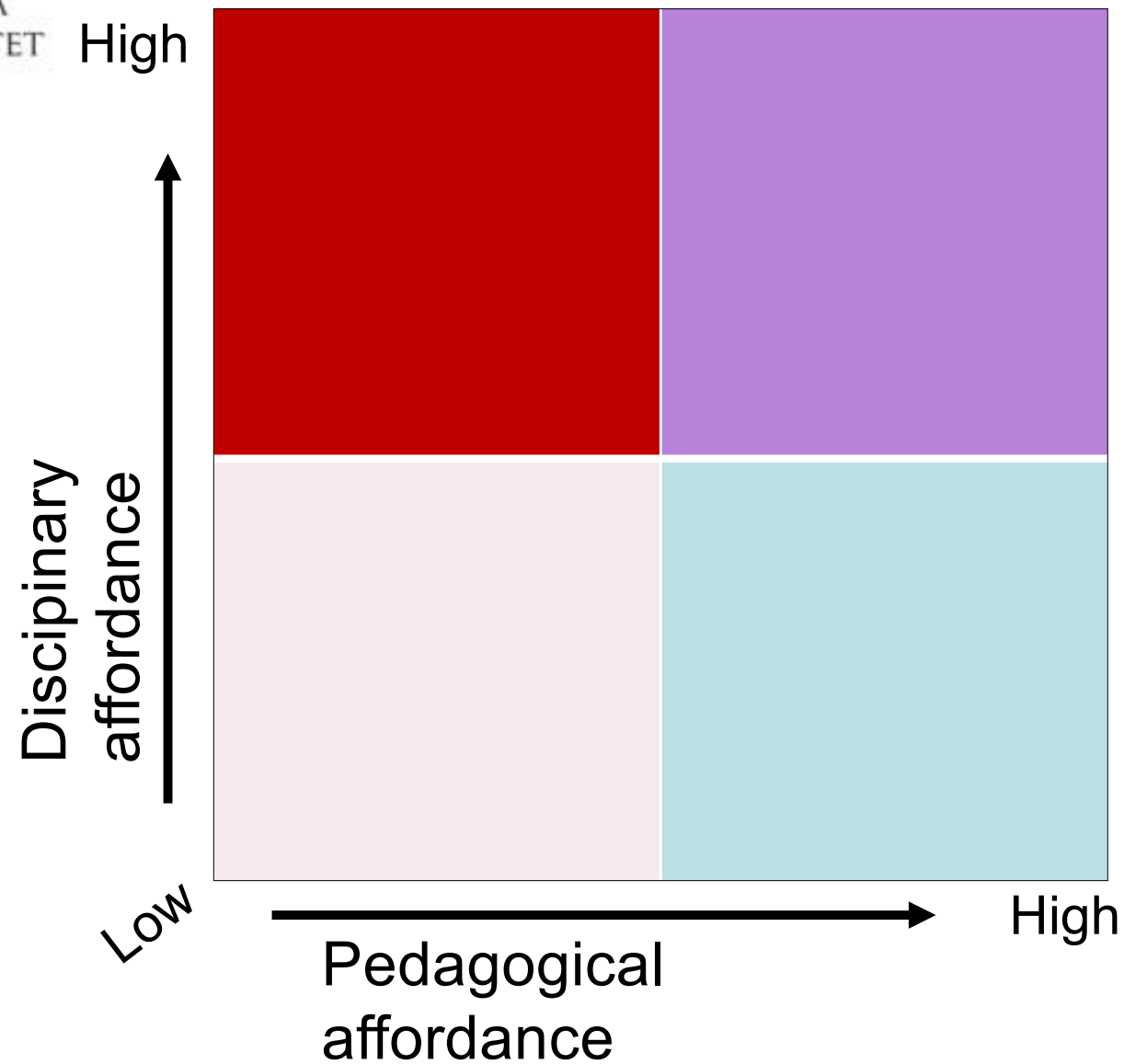
Airey (2015); Airey & Linder (2017)

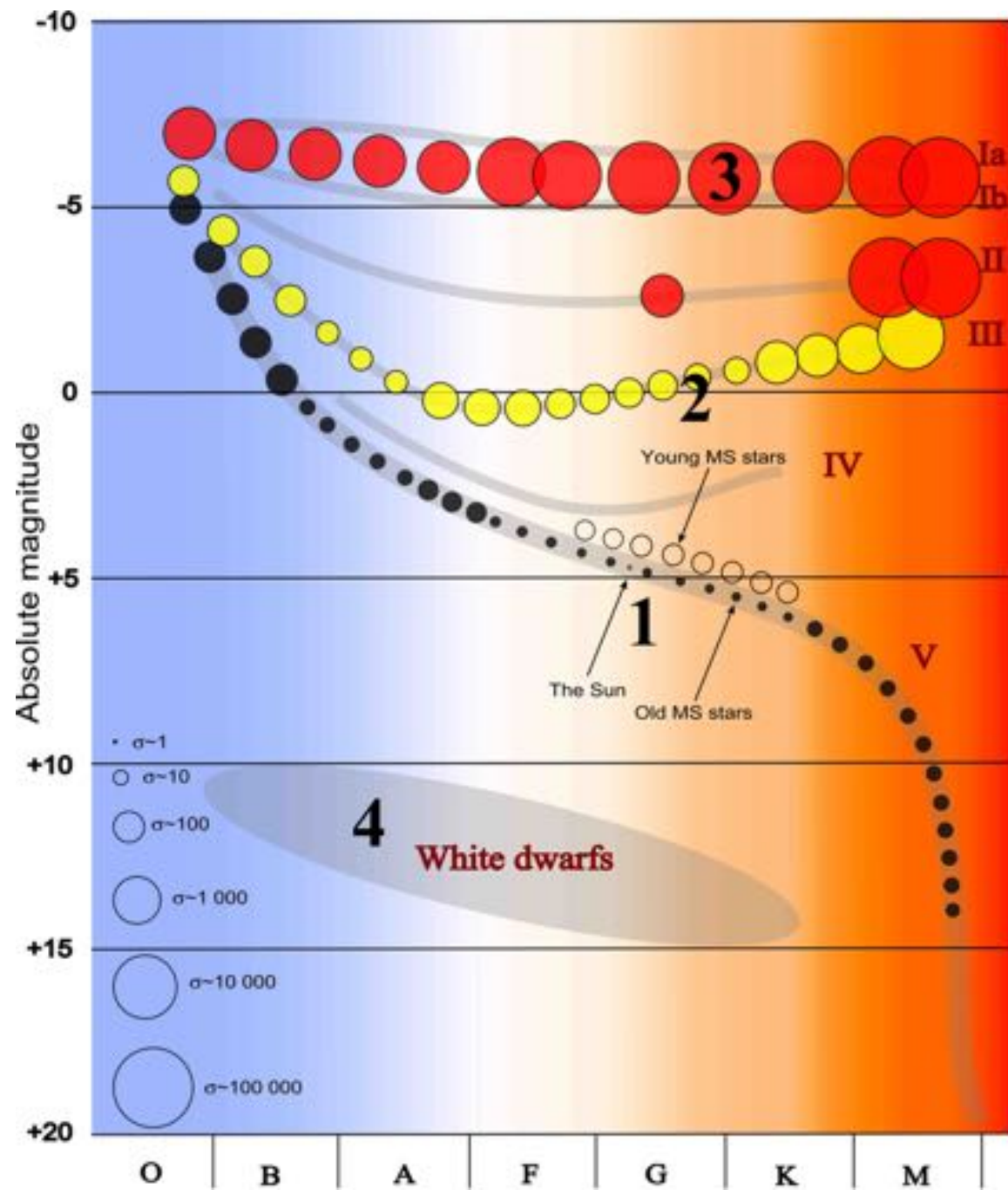
Disciplinary
affordance



Pedagogical
affordance







Airey & Eriksson (2019)

Disciplinary discernment

Too much information

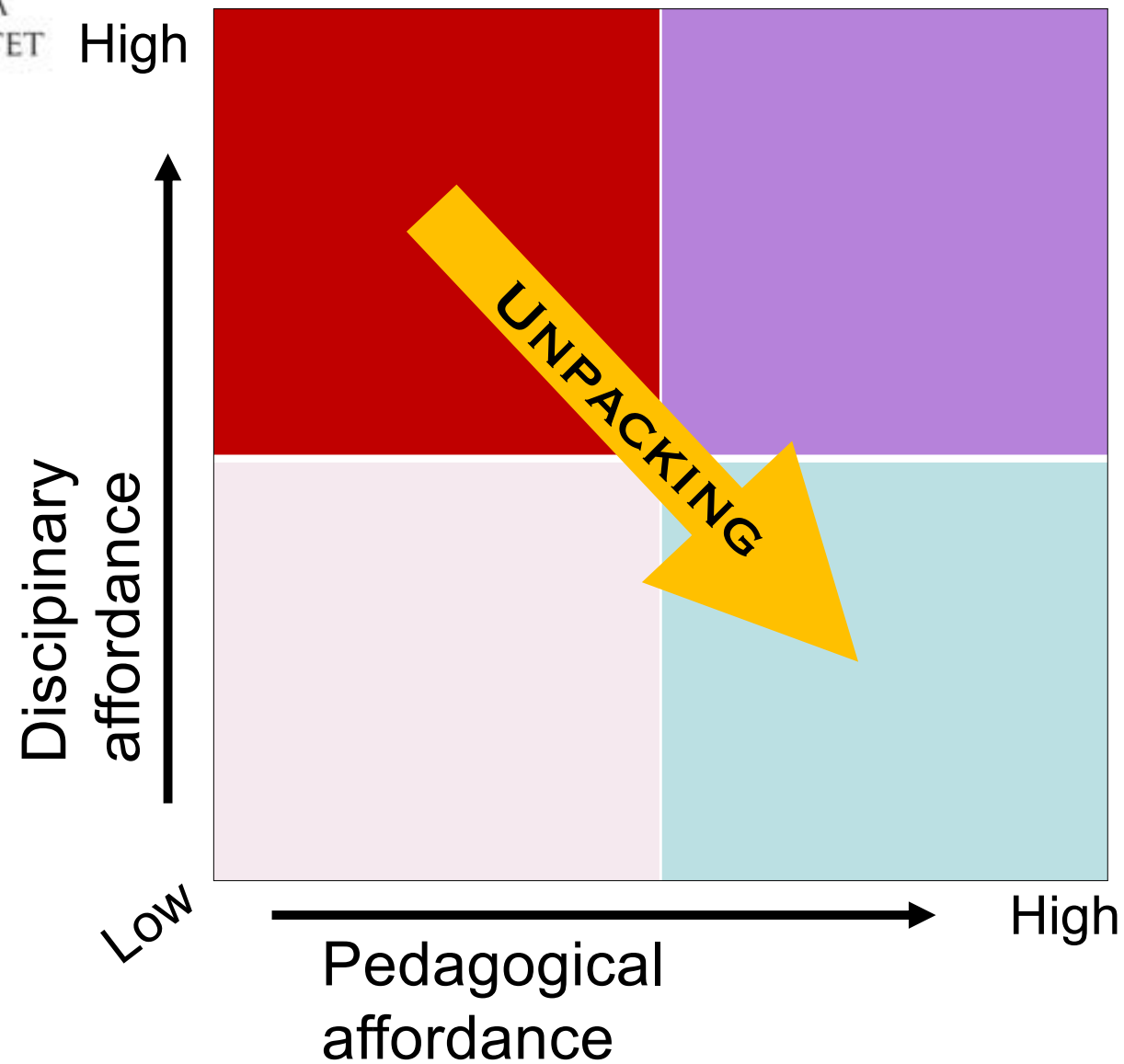
Students don't know where to look!

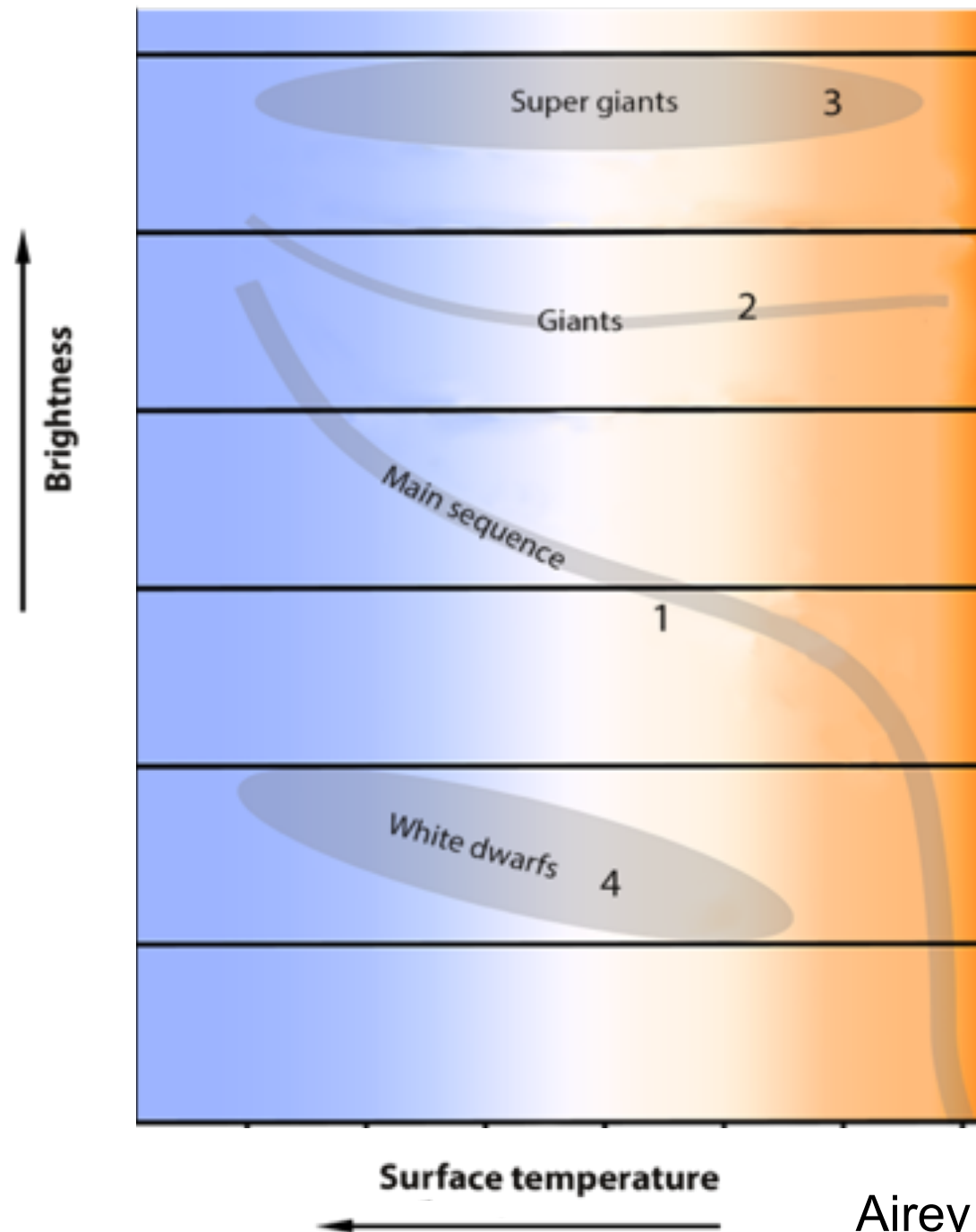


Simplified and re-structured the information



See Fredlund, Airey & Linder (2015)





Airey & Eriksson (2019)

Conclusion

In university physics education we discovered:

- **There are a lot of student misconceptions**
- **We know how to deal with many of them**
- **We found this out empirically**

How will future physics lecturers be introduced to this important body of work?

Is the same true for other disciplines?

Pedagogy, Didactics or something else?

I suggest **discipline-based education research**.

What (mis)conceptions do students come to us with and how can these be addressed?

Solutions to known problems in the discipline.

Moves from **specific cases to general theories** rather than presenting general theories that teachers need to apply to their teaching.

Takes account of disciplinary teaching traditions.



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Questions and Comments

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