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# On the disciplinary affordances of semiotic resources

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## Why affordance?

**Interested in learning**

**Specifically, relationship between physics knowledge and its representation**

**Physics lecturers need to understand what each semiotic resource they use affords (gives to) their students**



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## Overview

**Background to the term affordance**

**Multimodality and affordance**

**Critical constellations**

**Disciplinary affordance**

**Illustrations**

**Conclusion**



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## **Background to the term affordance**

### **Gibson (1979)**

**Interested in organism and environment**

**Affordance treated as a property of an object in relation to an organism**

***Affordance is an invitation to action that is inherent in the environment***



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## Background to the term affordance

### Critique:

Gibson treats affordance as an *inherent property* of an object.

An apple affords eating

The problem here is that affordance is *impossible to quantify*. A single object has multiple affordances depending on the setting and the organism.



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## Background to the term affordance

**Norman (1988)**

**Interested in design**

**Suggested that affordance is only that which is  
*perceived by the user.***



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## Background to the term affordance

### Critique

Norman addresses the problem of multiple affordances by suggesting affordance is only what it affords to one individual *here and now*.

This means that *affordance changes* depending on the individual and setting.

**Affordance is not a generalisable analytical unit.**





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## **Multimodality**

**Modality originally linked input through the senses:**

**Sight, hearing, smell, touch, taste.**

**Cognitive psychologists focus mainly on the first two senses i.e. visual and auditory modes.**



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## Multimodality

Often interested in *matching input* from auditory and visual modes:

**Cognitive load** (Chandler & Sweller, 1991)

**Dual processing theory** (Clark & Paivio, 1991; Paivio, 1986)

**Multimedia effect** Mayer (1997; 2003)



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## Multimodality

**Linguistic use of modes**

**Uses a looser definition of mode**

***Written language seen as a separate mode***

**Original interest in complementing/extending  
explanatory power of *systemic functional  
linguistics* using other *extra-linguistic materials*  
e.g. pictures**



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## Multimodality and affordance

Building on Lemke and others, Kress *et al.* (2001) suggested the use of affordance (and constraints) with respect to *modes* i.e. a move from the affordance of an individual **object to the affordance of a mode**

*Is speech say, best for this, and image best for that?*

Kress *et al.* (2001:1)

i.e. multimodality is interested in the *different* communication potential of modes



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## Multimodality and affordance

The affordance of a mode is shaped by its ***materiality***, by what it has been repeatedly used to mean and do (its '***provenance***'), and by the ***social norms and conventions*** that inform its use in context – and this may shift, as well as through timescales and spatial trajectories.

Glossary of multimodal terms (Mavers)



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## Critical constellations

**Airey & Linder (2009)**

**Build on Kress to propose**

***A critical constellation of modes***



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## **Critical constellations**

**Experiencing science concepts can be likened to viewing a multi-faceted object from different angles**

**Each mode allows us to ‘view the object’ from a different angle**



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## Critical constellations



Airey & Linder (2009)

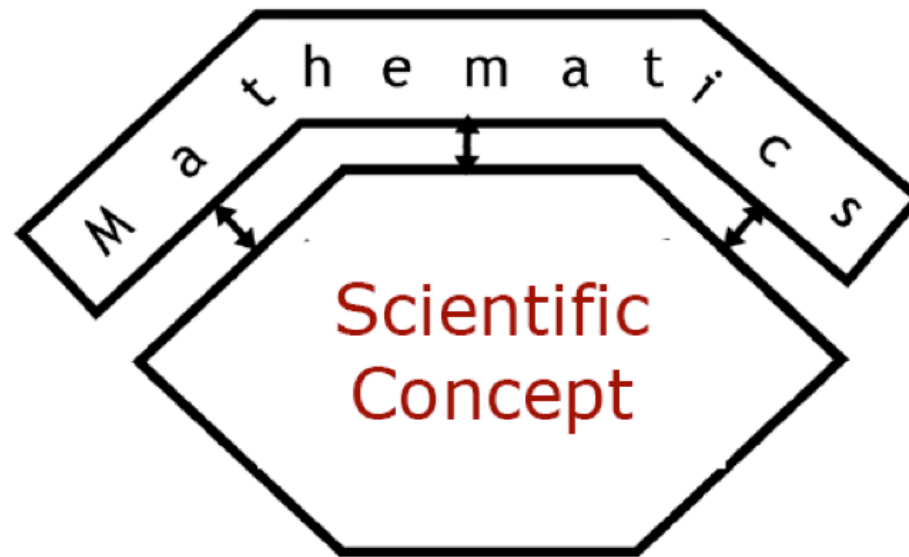
**This hypothetical scientific concept  
has six separate attributes or **facets****





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## Critical constellations



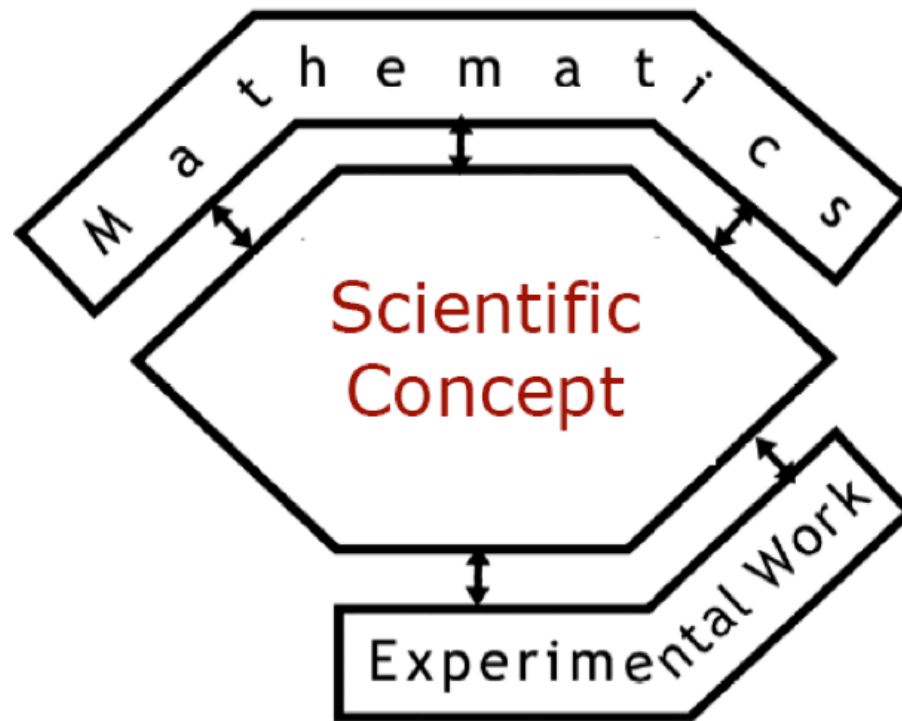
Airey & Linder (2009)

**A mathematical resource **affords access** to three of the six facets of the scientific concept**



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## Critical constellations

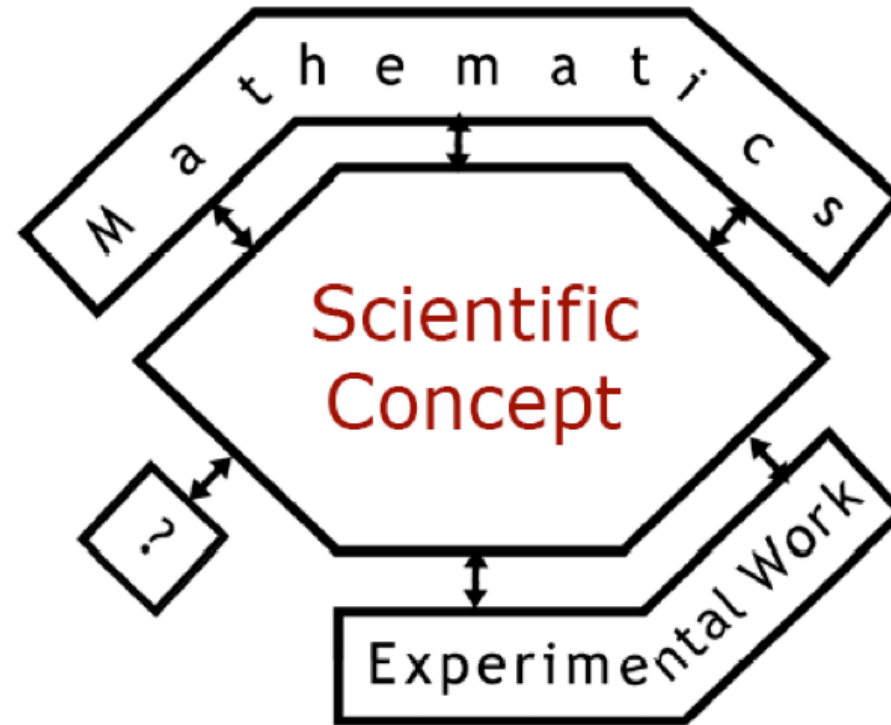


Airey & Linder (2009)



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## Critical constellations

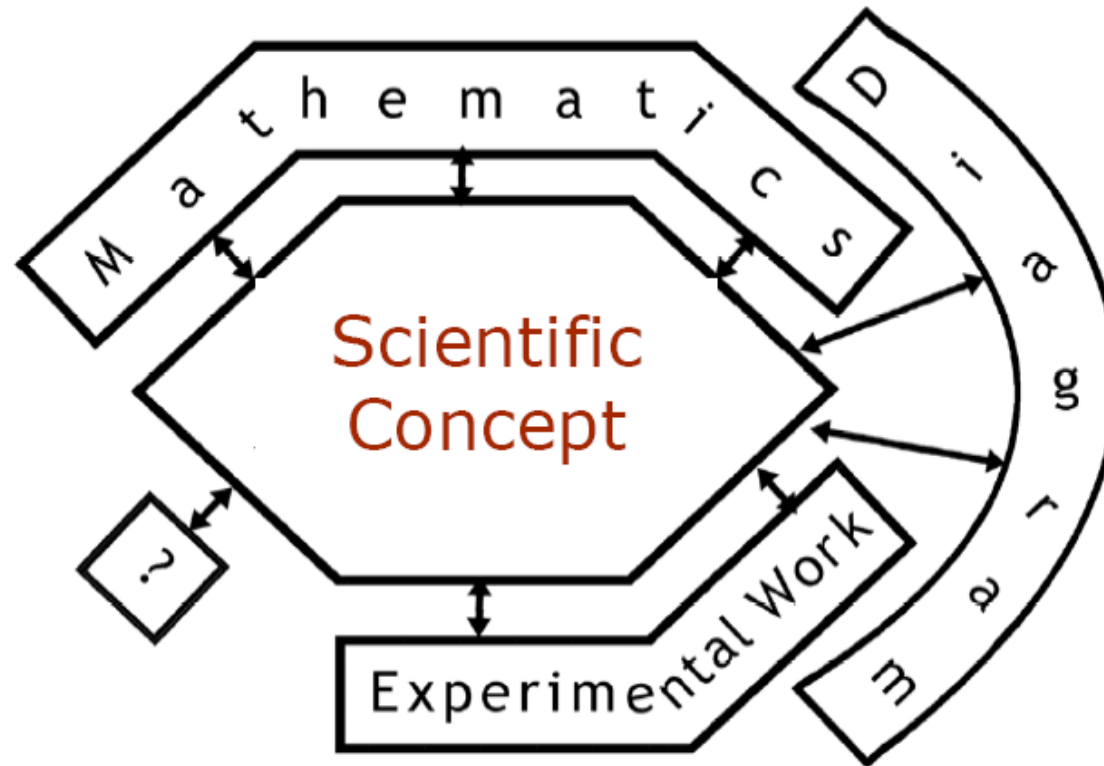


Airey & Linder (2009)



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## Critical constellations



Airey & Linder (2009)



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## Critical constellations

- So, for Airey & Linder (2009), learning a particular physics concept is seen as becoming *fluent in a critical constellation of modes*
- i.e learning to use the various modes in an appropriate, disciplinary manner



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## Disciplinary learning

Interested in disciplinary learning

Airey and Linder's (2009) critical constellation is useful but focuses on the **system of modes**

Found we need a finer-grained unit of analysis

Need to differentiate affordance ***within modes***

Want theory to allow two things in the ***same mode*** e.g. two diagrams to have ***different affordances*** within a discipline.



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## Critical constellations

**Airey (2009)**

Modified the earlier claim to suggest a ***critical constellation of semiotic resources***

Clearly, semiotic resources **within the same mode** can have different affordances

Shifts focus from the affordances of modes to the affordances of individual semiotic resources and their collective affordance

Linder (2013)



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## Disciplinary affordance

**Fredlund *et al.* (2012) suggest the term  
*disciplinary affordance* for semiotic resources**





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## Disciplinary affordance

### Definition:

*The potential of a given semiotic resource to provide access to disciplinary knowledge*

Fredlund et al. (2012:658)

**Deals with individual semiotic resources**

**Signals a break with earlier work on affordance**

**Focuses on the *discipline's* interpretation of the resource rather than the learner's experience**



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## Disciplinary affordance

**Disciplinary learning can be problematised in terms of *coming to appreciate the disciplinary affordances of semiotic resources***



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## Disciplinary affordance

Appropriate disciplinary learning only possible when there is a *match* between:

- **what a given semiotic resource affords to the student** (cf. Gibson & Norman)

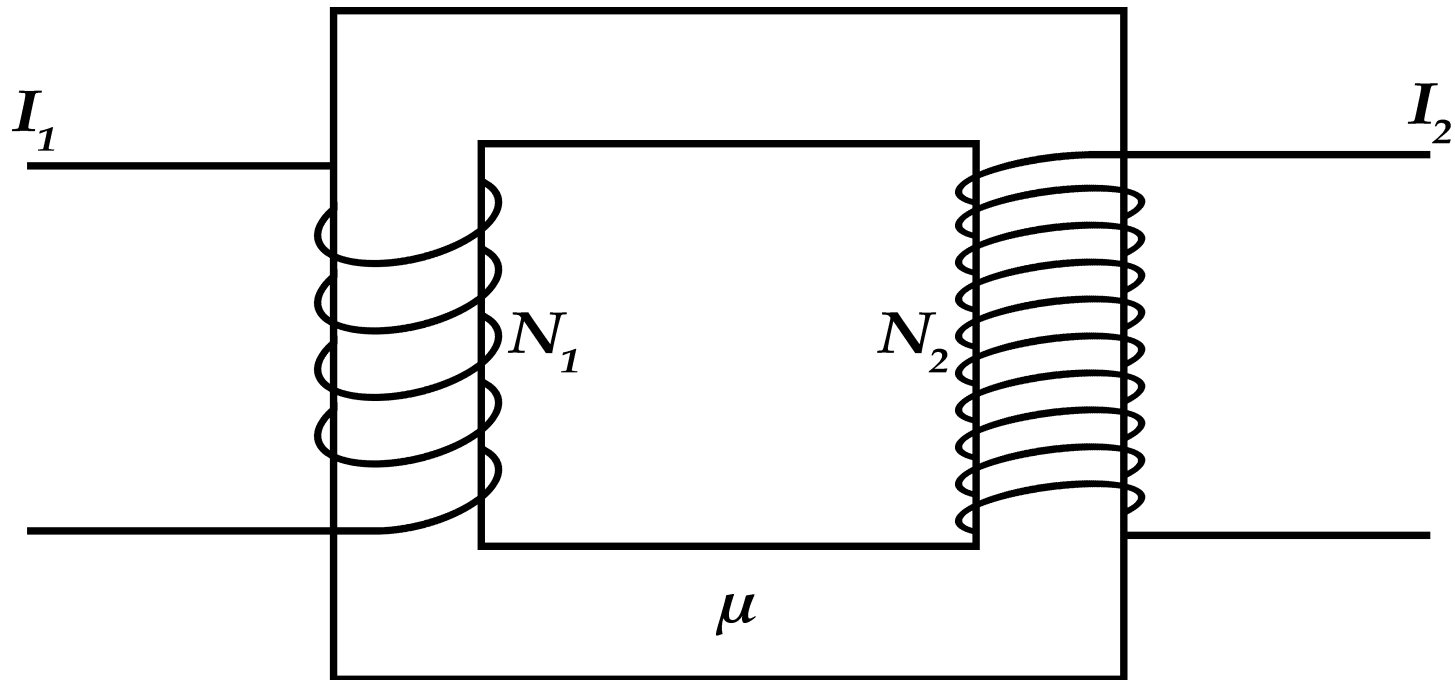
And

- ***its disciplinary affordance***  
(i.e. what it affords for the discipline)



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## Illustrating disciplinary affordance





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## Illustrating disciplinary affordance

Interviewer: *This is him starting this thing about transformers—  
what did you think about this particular part?*

Student: *Ummmh. Yeah, I don't know what this is. I didn't  
know what he was writing...*

Interviewer: *Okay, he's drawing some kind of diagram, but you  
don't really know what that is that he's drawing?*

Student: *No.*

Interviewer: *Okay, so...*

Student: *And I think it's quite often like that in the lectures  
he's drawing something on the whiteboard and he  
assumes that we know this from before.*

Interviewer: *You've got no idea what this transformer thing is?*

Student: *[laughing] No.*



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## **Illustrating disciplinary affordance**

**Clearly this student has not experienced the disciplinary affordance of this semiotic resource**



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## Illustrating disciplinary affordance

$$\nabla \times E = 0$$

*Equation written by the lecturer on the whiteboard*

Interviewer: *You've seen these equations before..?*

Student: *Yeah I've seen them before er... but I really don't know exactly what they mean [laughs].*

Interviewer: *Can you tell me what this means to you?*  
*[pointing to the equation  $\nabla \times E = 0$ ]*

Student: *Um, I think the E is er the intensity of er an electric field. And then the curl of E... [quietly to herself] mmh equals zero...  
Erm, I think this is erm a conservative vector field— and I know how to calculate it but I don't know what it means.*



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## Illustrating disciplinary affordance

**Again the student has not experienced the disciplinary affordance of this semiotic resource**

**The student can "read" the resource and use it to calculate but the meaning is still hidden.**

**Both the term "conservative vector field" and the student's calculations are correct, but the student is nevertheless only *imitating the discourse* (Airey, 2009)**





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## Summary

**For learning, focusing on multiple modes is often an inappropriate unit of analysis.**

**Rather, each individual semiotic resource has a particular *disciplinary affordance* Fredlund *et al.* (2012)**



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## Conclusions

Lecturers need to unpack the *disciplinary affordances* of the semiotic resources they use in teaching.

Little is known about these individual disciplinary affordances in physics.

Even less is known about the *critical constellations of semiotic resources* that are needed for appropriate knowledge construction.



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