How do we learn and work in a disruptive and changing future?

A Provocation by Alan Cheville
Bucknell University

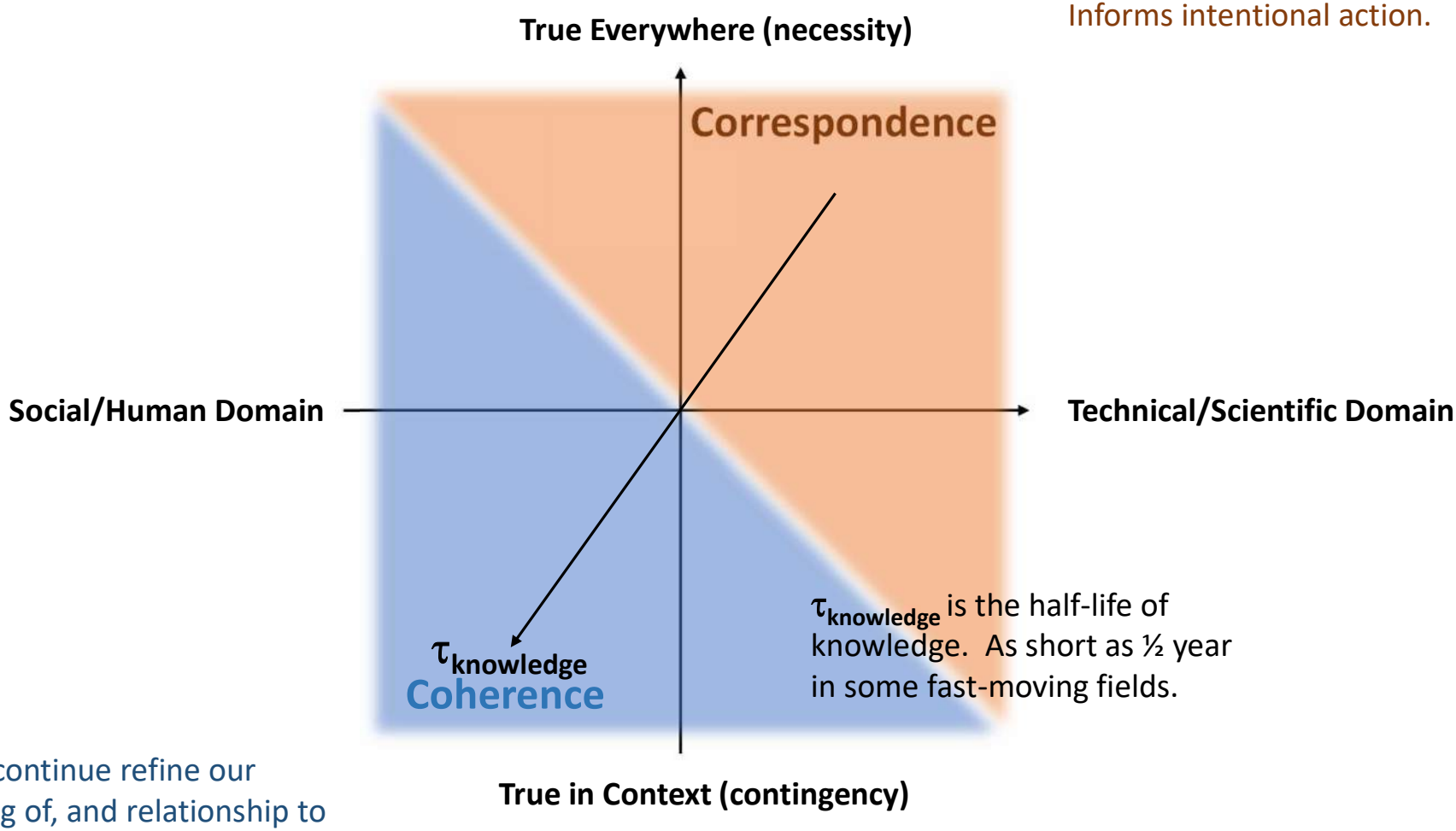
Provocation

We are not educating students in a way that will help them to address emerging challenges

- The economic benefits of engineering are becoming increasingly disconnected from its personal meaning. As a result students recognize that while engineering remains the path to a comfortable life, it is not necessarily the path to a good life.
- Engineering's success has led negative systemic side effects—on environment, climate, and societal equity—that can no longer be conveniently ignored. We often fail to teach that engineers cause problems as well as solve them.
- If engineering cannot reflect the diversity of our society it will not have the moral authority it needs to address systemic challenges.
- If lack of representation is a societal injustice, then by seeking to improve engineering education without first addressing equal representation we are perpetuating injustices.
- Injustice and catastrophe are tightly coupled.
- Higher education as a system is being squeezed by economic and cultural pressures that is causing it to become increasingly authoritarian. Those within this system fight back.

Engineering Ways of Knowing

Correspondence: create valid mental models of an objective reality. Informs intentional action.

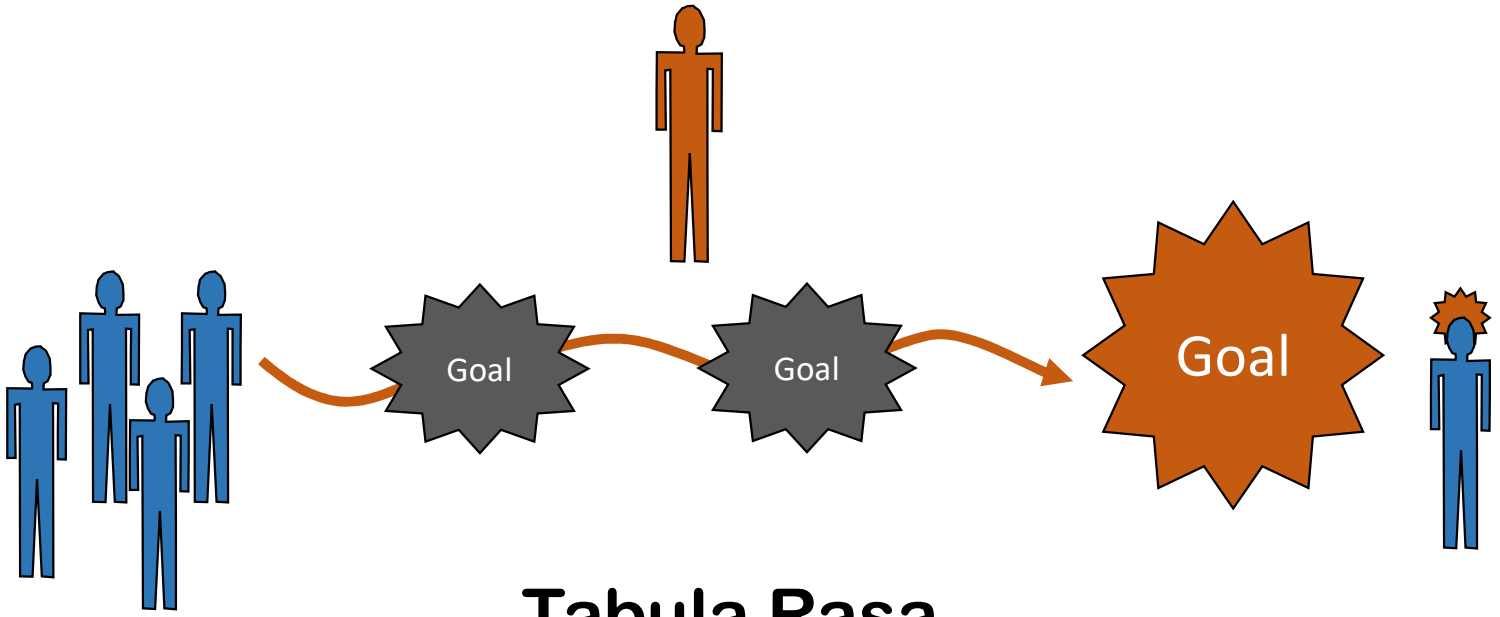


$\tau_{knowledge}$ is the half-life of knowledge. As short as ½ year in some fast-moving fields.

Coherence: continue refine our understanding of, and relationship to our environment. Informs habitual action.

Models of Learning

Correspondence: create valid mental models of an objective reality. Informs intentional action.



Tabula Rasa cognitivism

Goal = internal representation of external reality defined as a learning outcome

Models of Learning

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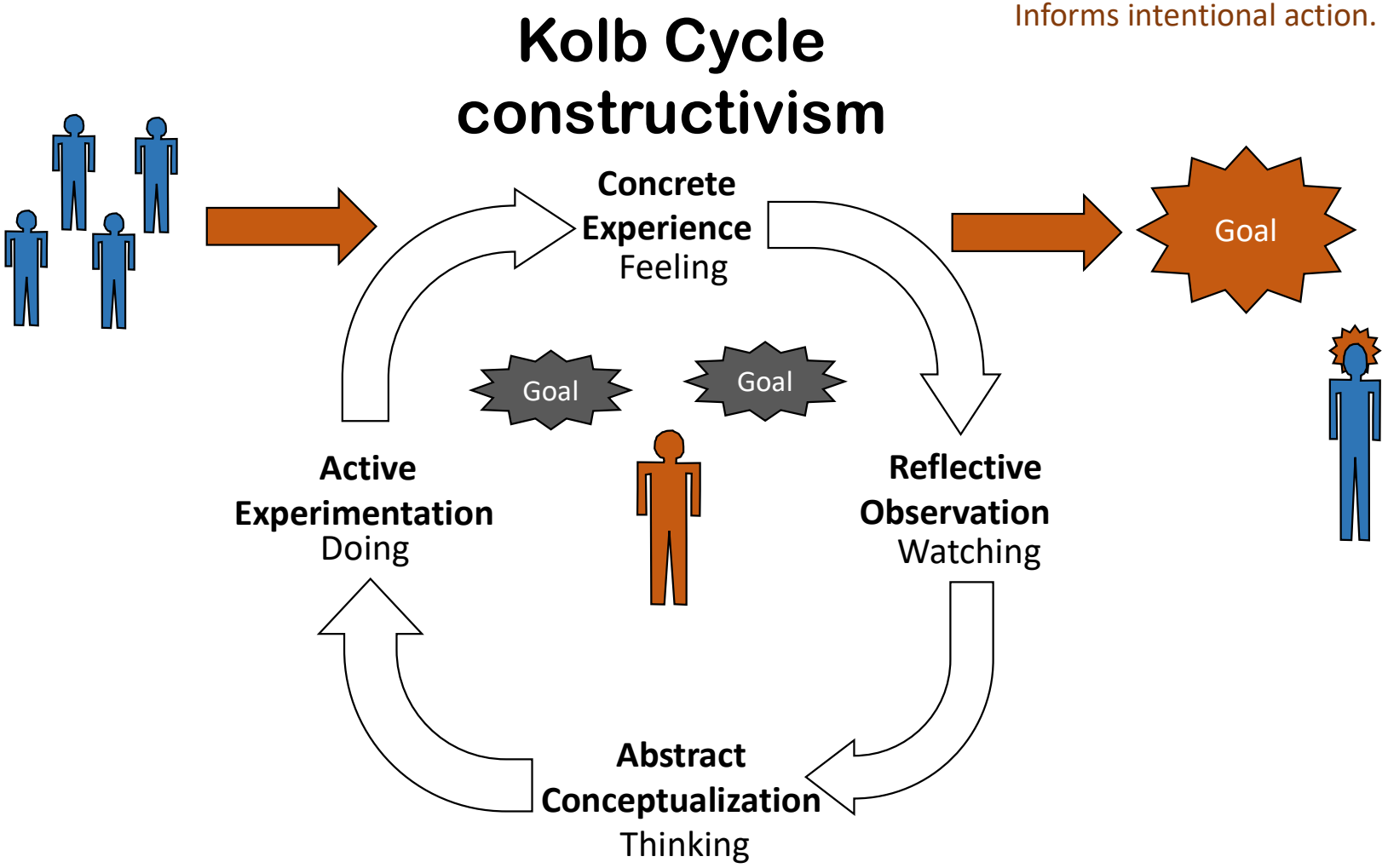

Models of Learning

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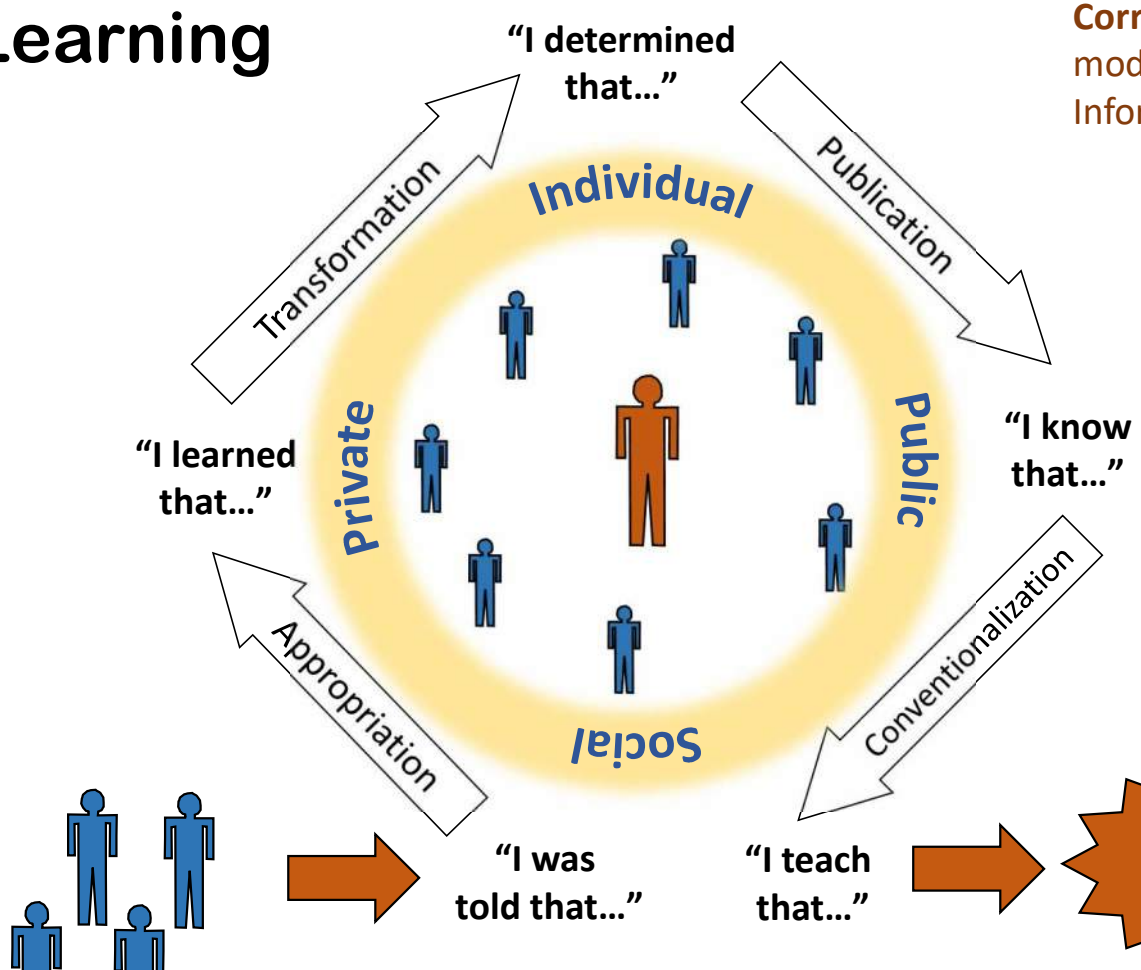
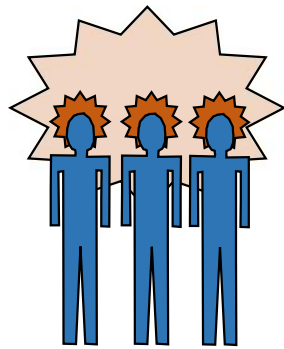




Vytgotsky Cycle
social constructivism

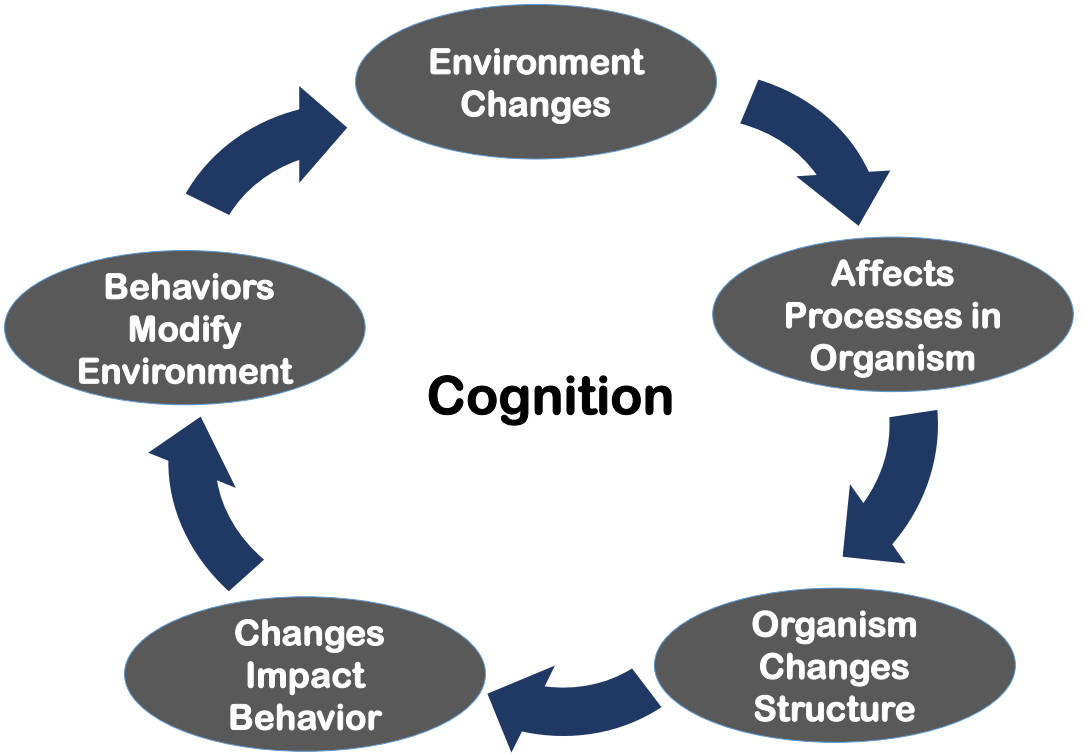
Models of Learning

Enactivism

- Philosophy: Heidegger and Gadamer
- Indigenous societies and knowledge
- Biology and ecology
- Complex systems theory

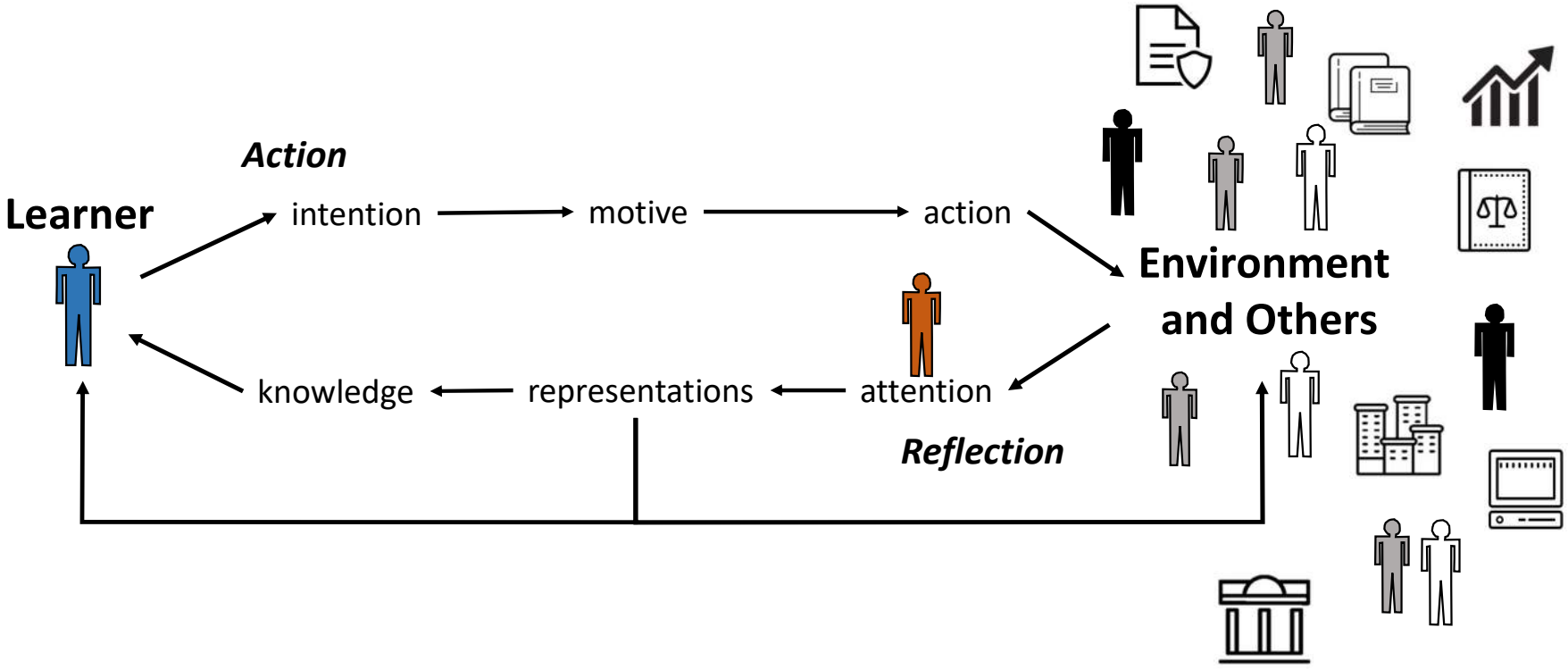
Coherence: continue refine our understanding of, and relationship to our environment. Informs habitual action.

Santiago Theory:
Cognition = adaptation through structural coupling



One Ecosystem, Multiple Worlds
Coupling of external and internal worlds

Learning Models for a Dynamic World



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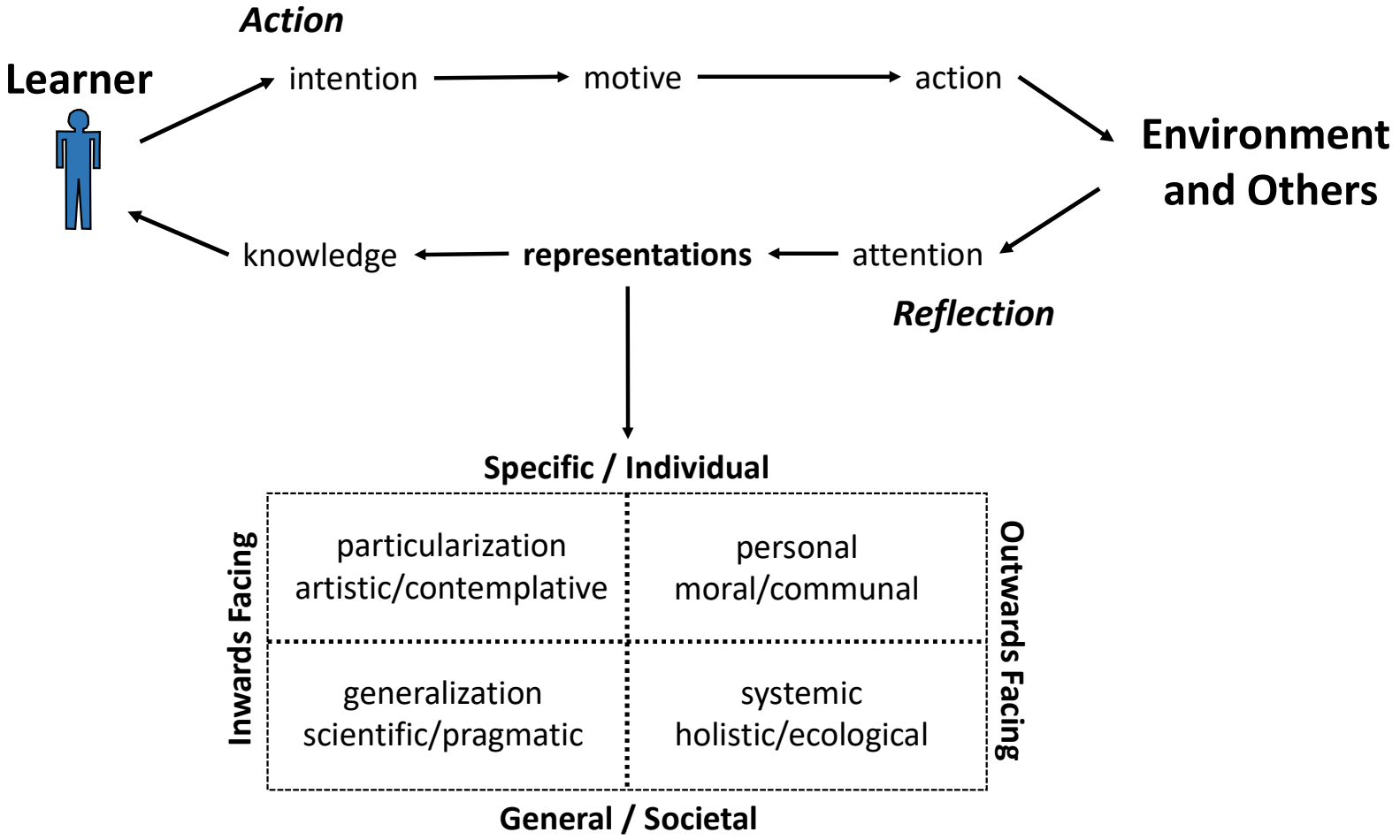
Four Forms of Representation



Specific / Individual

particularization: artistic/contemplative

- Supports the individual's emotional development and ability to find significance in their actions → emotions can be developed through action in the same way intellect is developed.
- More difficult to develop than the pragmatic mode.
- Does not extend the agent's capacity for action, but rather helps to better understand one's own values and identity.
- I cannot speak for what you should value or, if we value the same things, what aspects are of value to you ⟶ need for autonomy in education.
- The crowded nature of most engineering curricula do not leave time or offer necessary support to develop individual values.

personal: moral/communal

- Enables the agent to act in a heterocentric manner, for others, and build community.
- Addresses morality – the proper form of our relations with others.
- By emphasizing professional ethics rather than moral good, engineering neatly sidesteps many concerns.
- The type of friendship network we have and what groups we associate with matter.
- The quality and meaningfulness, or heterocentricity, of relationships matters more than number of relationships.

generalization: scientific/pragmatic

- Attention is focused inwardly on developing the means to improve subsequent action.
- The agent's world or environment come to serve as a means to future action.
- This mode is predominant in engineering (education).
- The pragmatic mode leads to an over-emphasis on education as a means and corresponding neglect of the ends it serves.
- Too much focus on efficiency undermines regard for persons → organizations and societies that undervalue being human have profound negative impact.

systemic: holistic/ecological

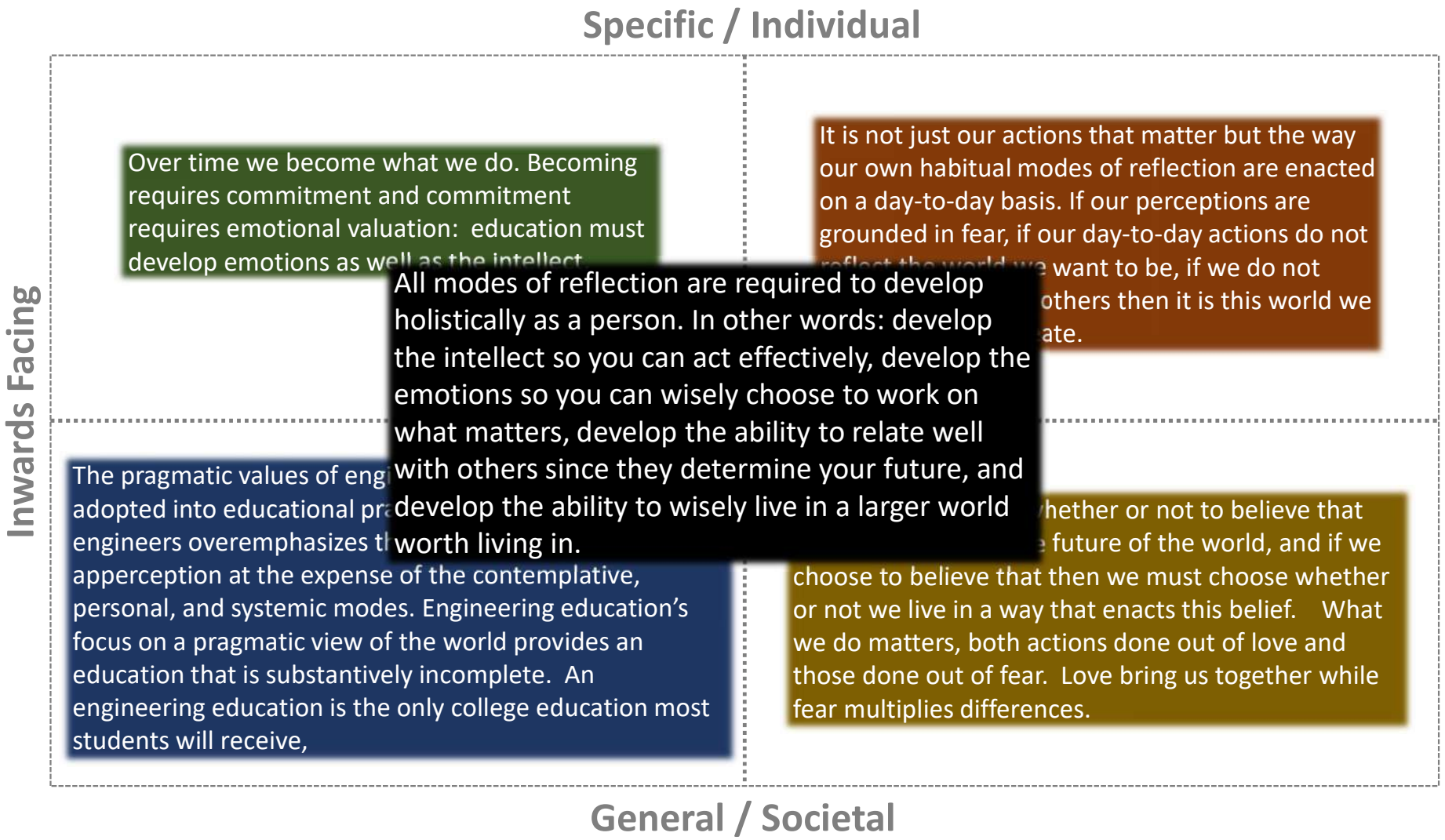
- Being a part of the world and a belief our fate is tied to that of others and the larger world.
- Care and empathy for the larger system in which we exist.
- Supported by:
  - activism,
  - contextualizing engineering work with larger systems,
  - constructing stories about alternative realities as an ongoing recursive process, and
  - rejecting deficit mindsets in favor of understanding structural inequalities.
  - rejecting scarcity mindsets in favor of sufficiency and equity.

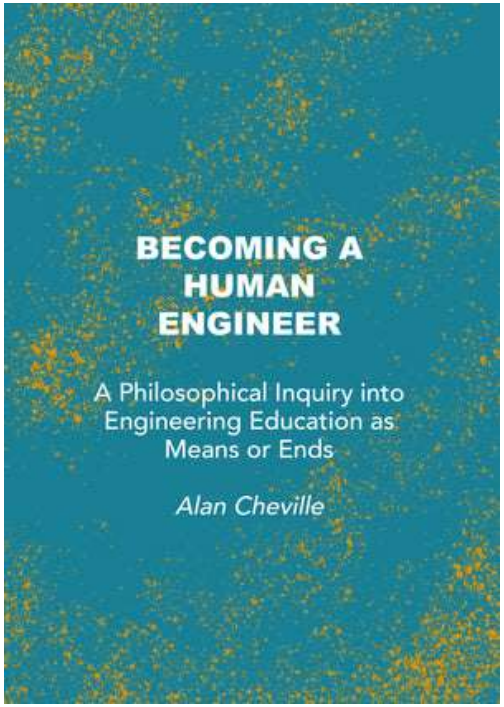
Inwards Facing

Outwards Facing

General / Societal

Take-Aways: *"The students are always learning, just not always what we are teaching."*





Just a quick shameless pitch that I did not include in the talk… These ideas were developed from ideas published by the philosopher John Macmurray in his two books covering his Gifford Lectures: The Self and Agent and Persons in Relation.

During a sabbatical year I took these ideas and tried to apply them into some part of a philosophy of engineering education. So if, and that is a big if, this topic interests you more I have posted the cover of the book at left and a link to the publisher below.

Alan

https://ethicspress.com/products/becoming-a-human-engineer-a-philosophical-inquiry-into-engineering-education-as-means-or-ends