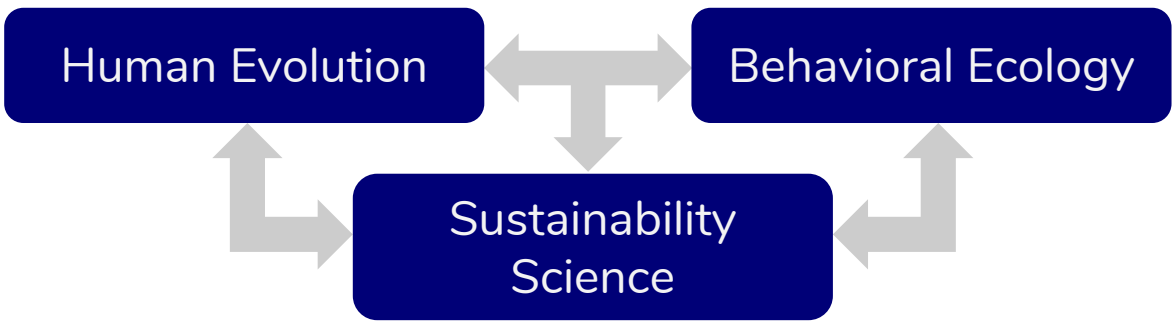
Global ESD



A Teacher's Guide to Evolution, Behavior, and Sustainability Science

Susan Hanisch, Dr.rer.nat.
& Dustin Eirdosh, M.Sc.

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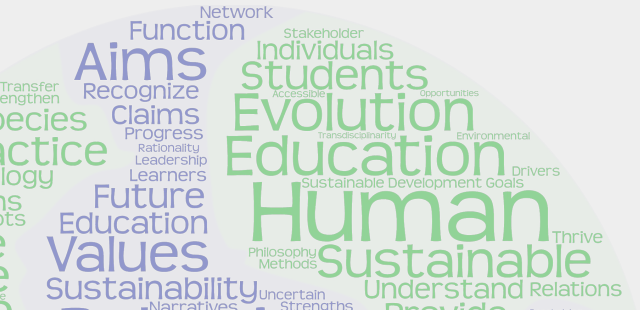
www.**GlobalESD**.org



Dear Reader,

This guide is intended for educators, students, and others, from all subjects and grade levels, interested in advancing Education for Sustainable Development through the lens of Evolutionary Anthropology.

Education for Sustainable Development (**ESD**) is a UNESCO-led global program. The aim is to promote skills and understandings in students in relation to the challenges of global sustainability, enhancing the capacity of communities to take action towards shared values and goals. Many approaches, frameworks, and teaching materials already exist worldwide to support these aims.

Our work is complementary to this global discussion, adding the context of evolutionary and behavioral sciences as a valuable lens for understanding scientific perspectives on sustainability from local to planetary scales of social organization.

The purpose of this guide is to offer an introduction to the **big ideas** and **core understandings** from across the evolutionary, behavioral, and sustainability sciences. A set of **practical tools** for teachers can help you to **adapt and design lessons** for classrooms anywhere in the world.

This is an evolving document, with content and additional resources being added and refined based on new insights from our network of educators and scientists. This guide outlines three practical *design principles*, eight *content anchors*, and a number of *teaching tools* that can be integrated to create a wide diversity of lessons and units working towards the big understandings of human evolution, behavior, and sustainable development. Links to specific teaching materials and guidance for unit design are provided at the end. We invite you to **get involved!** Think about how the ideas and content in this guide relate to your everyday experience and to your classroom learning aims. **Try things out** and **connect with us** to share your experiences or **ask us a question.**

Best Regards,
Susan & Dustin

www.GlobalESD.org
Susan@GlobalESD.org
Dustin@GlobalESD.org

Contents

Evolution, Behavior, and Sustainability

Today's global society faces major challenges in ensuring resource availability, social equality, peaceful coexistence, access to good education, health and human well-being for all. The United Nations has identified 17 global goals for sustainable development, aiming to reach specific markers of success in each area by the year 2030.

The 17 Global Goals for Sustainable Development identified by the United Nations

All of these goals require **collaboration** and **collective learning** across many levels of society, including up to the unprecedented scale of global cooperation.

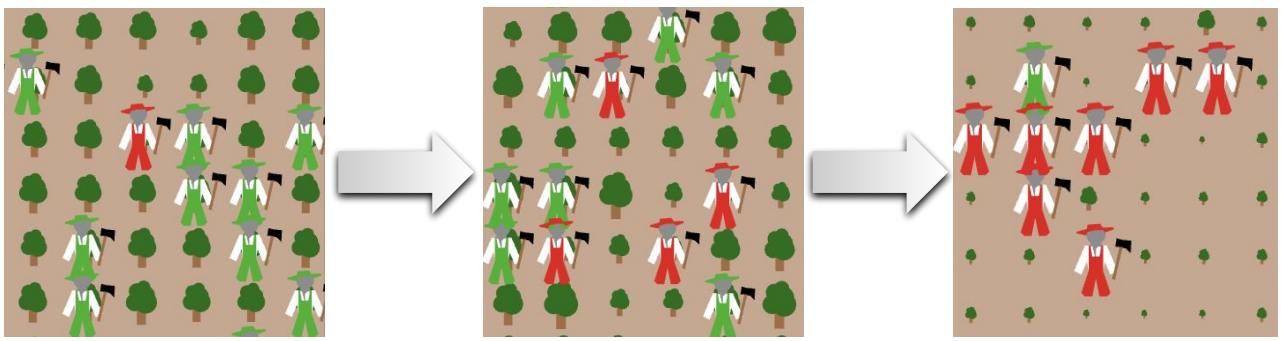
What can we learn from **other living beings,** from our **evolutionary history as a species**, from our **everyday experiences and behaviors**, and from **communities around the world** about how these challenges of cooperation can be mastered and which factors might hinder this cooperation?

Research in biology, economics, anthropology, psychology, and behavioral sciences offer us clues as to **which conditions and principles play a role** in enabling the sustainable development of diverse communities across multiple scales of social organization.

Box 1. The basic dilemma of using shared resources

Sustainable development is, ultimately, about the maintenance of shared, limited, natural and social resources. In such situations there is always the threat of competition between individuals endangering the maintenance of the shared resource, and thus the sustainability of the whole community.

Individuals often have an interest in using as much of the resource as possible (or contributing as little as possible to the conservation of the resource). After all, their behavior may have no immediate negative consequences. However, when most people in the community act like this, the entire resource is endangered, with negative consequences for everyone. This **dilemma between short-term personal advantage and the long-term common good** in the use of shared resources is called the **tragedy of the commons**[1].



The Common-Pool Resource Dilemma: What prevents an individual from taking as much as possible from the resource? Greed and envy may then entice others to increase their resource use as well. After all, nobody wants to be "the fool". However, if everyone does so, resource availability is jeopardized for all.

The tragedy of the commons is an important concept in the evolutionary, behavioral and sustainability sciences, and presented a puzzle for a long time. After all, we can observe that many species of animals, as well as many groups of people, have apparently managed to cooperate and thus prevent the tragedy of the commons.

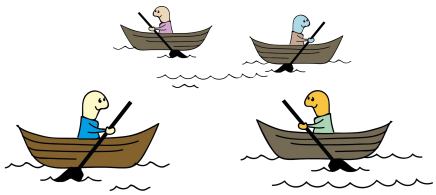
What conditions and behaviors enable them to do this?

[1] *sensu* Hardin (1968)

Box 2. Are we “all in the same boat”?

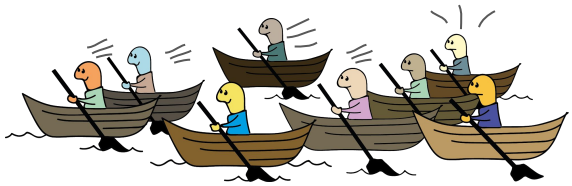
The use of community resources is a dilemma only when the interests of individuals are not clearly in line with the interests of the community. Biologists, behavioral scientists, and sustainability scientists like to use the **boat-analogy** to describe situations in relation to how individuals' interests are related to the interests of others, whether self-interest and collective interest are in line or opposed.

- **Does everyone sit in his or her own boat**, only concerned with their own direction? Is it irrelevant to one's survival how those in the other boats behave? **Then there is no social interaction, neither competition nor cooperation.**



- **Is everyone sitting in the same boat?** Is the success or failure of one the success or failure of the others? Then we can expect that, over time, cooperation emerges - everyone has the same aim, because everyone is interested in moving their boat together towards a safe destination. **Those groups that cooperate better than other groups will have an advantage in the long-term.**

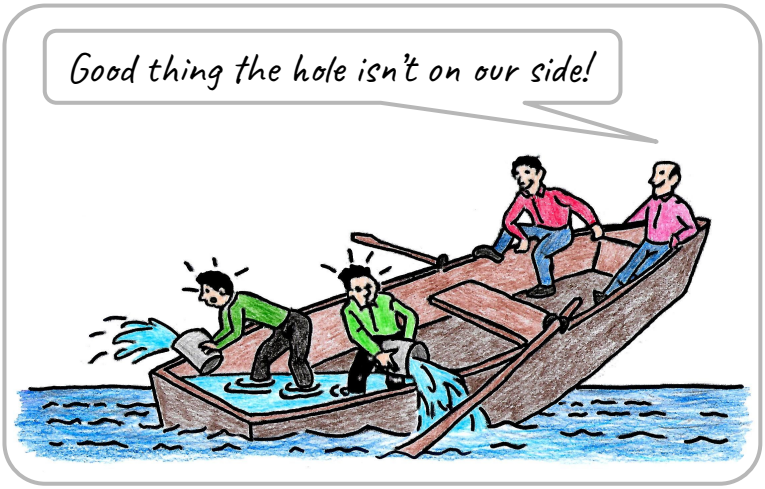
- **Does everyone sit in his or her own boat, and are all boats in a race?** Does the victory of one equal the defeat of the others? Then we can expect that there is competition - all are interested in defeating the other boats. **Those who are faster, stronger, more efficient, or smarter than the others, will have the long-term advantage.**



Box 2. *(continued)* Are we "all in the same boat"?

In reality, situations rarely fall cleanly into one of these boat scenarios, or situations are constantly changing. Often self-interest and the common good are neither perfectly aligned, nor perfectly opposed. Selfish behavior is often worthwhile in the short term, but not in the long term. These unclear situations lead to a dilemma - between short-term individual advantage and long-term common good.

When everyone is in the same boat, it is beneficial for everyone to work together. Competition or cheating within the group can, sooner or later, lead to the downfall for everyone.



"Suppose that two people, Art and Bud, are at sea in a rowboat, trying to stay ahead of a violent storm. Neither will survive unless both row as hard as possible. Here self-interest and collective interest (in this case, a collective of two) are in perfect harmony. For both Art and Bud, doing what's best for "Me" and what's best for "Us" is the same. In other cases, cooperation is impossible. Suppose, for example, that Art and Bud's boat is now sinking and that they've only one life vest, which can't be shared. Here there is no Us, just two different Me's.

When cooperation is easy or impossible, as in the two scenarios above, there's no social problem to be solved. Cooperation becomes a challenging but solvable problem when, as in [the tragedy of the commons], individual interest and collective interest are neither perfectly aligned nor perfectly opposed. (...) The problem of cooperation, then, is the problem of getting collective interest to triumph over individual interest, when possible. The problem of cooperation is the central problem of social existence."

Joshua Greene (2013), p. 20

Evolution, Behavior, and Sustainability

Challenges of sustainable development are not fundamentally new to us humans. Throughout our **evolutionary history**, our species has been confronted time and again with **challenges of collaboration**, collective decision-making, and the sharing of limited resources. This is because our ancestors lived in groups where everyone was **"in the same boat"** - everyone was dependent on preserving the group and its resources, both natural and social. These challenges have significantly **shaped the cognitive and social skills, as well as behaviors and cultures of our species.**

In this context, an **understanding of the causes and consequences of human behavior**, as well as of the **causal relationships that have shaped our past, shape our present, and will shape our future**, can help us understand today's challenges to human well-being and sustainable development. Understanding the context of these challenges is central to our capacities to evaluate possible solutions.

Exploring **human behavior** in the classroom offers further learning opportunities. Students of all grades, and humans in general, are very interested in human behavior - **we experience it on a daily basis** and we are constantly concerned with and imagine its causes and consequences. In addition, human behavior is **implicitly or explicitly integrated in the curricula of many subjects**, especially in biology, social studies, history, geography, and ethics.

The research questions, concepts, methods and findings of evolutionary anthropology, behavioral science, psychology, and sustainability sciences offer unique opportunities to explore the causes and consequences of human behavior in the classroom. They thus can contribute to a fascinating and interdisciplinary education that connects to our shared everyday experience and is relevant to pressing societal challenges.

The educational **design concept** presented in this document offers practical guidance for the development of teaching materials, lessons, and units that aim to support students and teachers in **reflecting on the everyday experience of human behavior in the light of evolution and sustainability**.

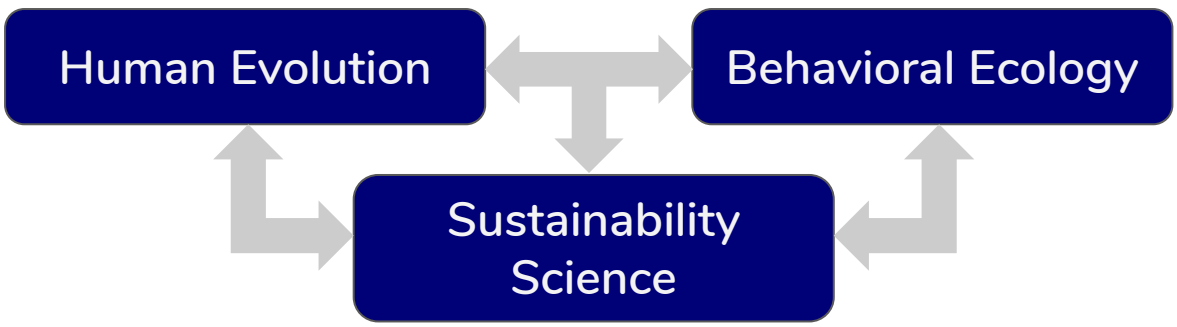
Design Concept

Our **educational design concept aims** to help students and teachers develop the skills to reflect on the causes and consequences of everyday human behaviors, and transfer these competencies to their own lives and to diverse sustainable development issues.

To achieve deeper understandings on the nature of human behavior and sustainability, isolated lessons are not enough. Rather, we need to think on several levels, including on the level of units and curricula.

The **strength of the educational opportunities provided by evolution, behavior and sustainability sciences** is the rich interdisciplinary nature of their core concepts, principles, methods, and skills. These fields are characterized by the exploration of transferable principles across contexts, enabling interdisciplinary discourse, and supporting engagement in the complex problems of human society. This richness in concepts and principles provides opportunities for achieving the competency aims of Education for Sustainable Development, and of interdisciplinary education more generally (→ p. 16).

For educators to leverage these opportunities, however, we **need to identify the key concepts, principles, methods, and skills that characterize these fields**, and to subsequently formulate overarching understandings, essential questions, and skills that can structure the design of lessons and units. **Conceptual teaching and learning** (→ Box 3, p. 9) provides a basic framework for educators to discuss and clarify these aspects of educational design. In this way, our design concept was developed to support you in integrating these ideas into your own teaching aims and school context.



Design Concept

What kinds of **teaching methods**, **content**, and **teaching tools** can help students and teachers develop the skills to reflect on the causes and consequences of **everyday human behaviors**, and transfer these understandings to **sustainable development** issues?

Design Principles

Overarching principles for the identification of content and teaching methods

Content Anchors

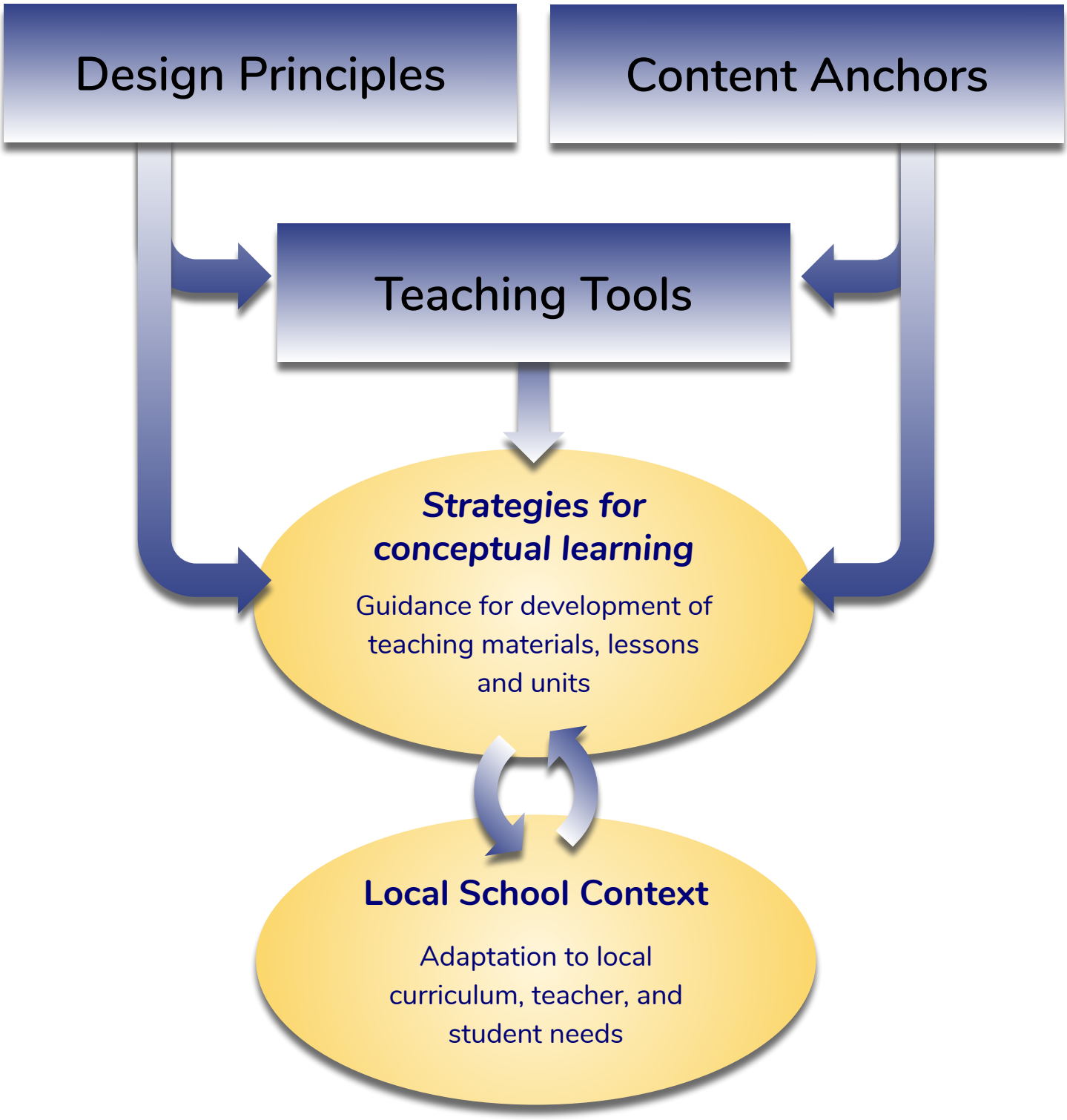
Cross-cutting content anchors reflect the methods and fields of inquiry of evolutionary anthropology, behavioral and sustainability science. From these, we identify content for the development of educational materials that can be used to explore concepts and essential questions around human evolution, behavior, and sustainability.

Teaching Tools

Teaching tools are used across diverse lessons to develop the skills that evolutionary anthropologists and sustainability scientists use in exploring the causes and consequences of human behavior, as well as the complex relationships in social-ecological systems.

Design Concept

Design Principles, Content Anchors and Teaching Tools can inform concept-based approaches to teaching and learning



Box 3. Teaching for conceptual understanding

Teaching for conceptual understanding[1] is an educational approach to help students achieve deeper and more transferable understandings of concepts and general principles within a theme, in contrast to the mere memorization of facts. This is because facts and knowledge on isolated topics alone do not transfer to new phenomena and are thus not enough if the aim is to cultivate in students competencies such as problem-solving, creativity, collaboration and perspective-taking, as well as the ability to apply such competencies in novel contexts. When students understand and transfer underlying principles, facts around particular content will become much easier to learn and retain than through rote learning alone. Concept-based teaching is complementary and can be integrated with many other teaching approaches, such as inquiry, project-based and cooperative learning or direct instruction.

Some important elements and steps for designing a concept-based unit and lessons are:

- **Identification of a set of concepts, generalized principles and skills that characterize a subject area.** These transfer across examples, across time and cultures. These are also the **understandings** and **skills** we aim students to develop as they explore various content throughout the unit.
- Formulation of more or less general or specific **essential questions** that help students to **uncover** and reflect on the deeper principles (generalizations) in concrete examples.
- Elicit student **pre-conceptions** at the beginning of a unit or lesson
- Provide students with various content examples to help them **transfer** and **refine** their understandings of generalized principles to new contexts, and practice applying particular skills.
- Have students **reflect and discuss on how their understanding is changing and developing** with every studied example, and on **how the understanding is relevant and significant** to themselves and their world.

[1]Erickson, Lanning, & French, 2017; Stern, Ferraro, & Mohnkern, 2017

Box 3 *(continued)*. Teaching for conceptual understanding

"We need to transform the goals of teaching and learning (curriculum) and not simply change the delivery method (instruction). When we organize our curriculum through fundamental and powerful concepts, our students are able to transfer their understanding to new situations and apply it in unique ways. In this way they create something innovative and world changing, becoming the next great innovators."

Stern, Ferraro, & Mohnkern (2017), p. 6

"It seems that the goal of all learning - not just Concept-based learning - is transfer. The key to understanding transfer is this: Facts and topics do not transfer. By this we mean that facts and topics can not be applied to a new situation. Whenever we try to apply our insights from one situation to another we are always abstracting to the conceptual level, generalizing from a specific instance to a broader rule, before our knowledge helps us unlock the new situation. Our brains are wired for this process."

Stern, Ferraro, & Mohnkern (2017), p. 15

"Our ultimate goal is to develop deep and lasting understanding in our students so that they can use their learning to tackle big, messy, real-world challenges ranging from climate change to domestic violence. Research tells us that in order to reach this goal, we must first expose, and then deal directly with, the pre-instructional understandings students bring with them each day."

Stern, Ferraro, & Mohnkern (2017), p. 48

Design Principles

Guidelines for identifying teaching content and methods for unit or lesson design

Focus on Human Behaviors

Focus on the aspects and everyday experience of human behaviors relevant to human well-being and sustainable development (e.g., prosociality, cooperation, sense of belonging, curiosity and creativity, learning and teaching, empathy and compassion, sense of fairness, perspective taking, flexibility, self-control, goals and values, health, prevention). *Focusing on human behaviors helps students relate to and understand the causes of biological and societal phenomena.*

Explore Complex Causality

Explore and reflect on the many causes and consequences of human behavior and on the complex causal relationships in human evolution, behavior, and social-ecological systems: How do immediate internal and external factors, as well as individual development and evolutionary history, function as causes of human behavior? Why do these mechanisms and patterns of behavior exist compared to other possibilities? What consequences do behaviors have for individuals and their environment, in the short-term and in the long-term? Diverse teaching tools such as causal maps and payoff matrices help in reflecting on these questions. *Exploring complex causality helps students understand and relate causal factors in the emergence of human behaviors.*

Teach for Transfer

Ensure students can **transfer** understandings to novel phenomena, everyday experience and relevant problems of sustainable development across multiple scales and contexts of global society, with the help of analogies, analogy maps, and other teaching tools. *Teaching for transfer requires the iterative exploration of diverse human behaviors and contexts.*

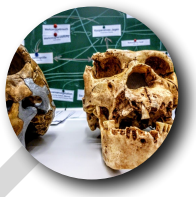
Content anchors

Content anchors help us explore concepts and essential questions around human evolution, behavior, and sustainability

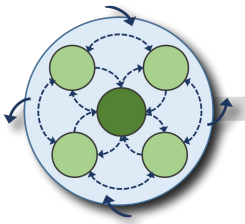
Cross-Species Comparisons

Child Development

Ancient Ancestors



Cooperation Games



Governing the Commons

Computer Simulations

Global Sustainability Goals

Our Mind

Teaching Tools

A diversity of teaching tools can support the development of overarching understandings and skills in students and teachers across content

Tinbergen's Questions

Our behaviors have many causes, from immediately prior factors, to events in our individual past, to factors in our cultural and evolutionary history. With the help of content anchors, we can explore these different kinds of causes. **Tinbergen's questions** are a helpful heuristic for **exploring and sorting these different types of causes.** → p. 81 ff.

Causal Mapping

The evolution and development of our behaviors, as well as the sustainable development of social-ecological systems, can not be attributed to single causes or linear cause-effect relationships. Rather, they are shaped by complex causal relationships. The **construction and discussion of causal maps** in the classroom cultivates in students and teachers an **understanding about such complex causal relationships in different phenomena.** → p. 84 ff.

Payoff Matrices

Evolutionary biologists, economists and sustainability scientists sometimes represent the costs and benefits that people (or other animals) get from a behavior through a so-called **payoff matrix**. Using payoff matrices in the classroom helps us **reflect on the possible motivations for and consequences of behaviors** in particular situations. → p. 88 ff.

Analogy Mapping

Because all learning involves developing a transfer of relationships among ideas or phenomena, analogies play an important role in science and education. They allow us to illustrate abstract concepts, to transfer overarching principles between content, and to use our understanding of familiar phenomena in order to understand new phenomena. The **discussion of analogies and use of analogy maps** in the classroom fosters **networked learning and learning transfer.** → p. 92 ff.

Design Concept

The following understandings, addressed misconceptions, essential questions, and skills form the foundation for the GlobalESD design concept.

Understandings

Students will understand that . . .

U1. Our everyday behaviors and experiences have many causes, some of which go all the way back to their evolutionary origins.

U2. Humans have been shaped by natural selection and cultural evolution to have an elaborated capacity to cooperate beyond kin.

U3. Our everyday behaviors can have many consequences, some of which may be intended or unintended, and some of which may expand into scales of distant time or space in the future.

U4. The evolution of human behavior is relevant to the sustainability dilemmas of today.

Addressed misconceptions

M1. Phenomena in biology and society are predominantly caused by the intentions of single agents.

M2. Evolutionary theory implies that selfish behavior is always adaptive.

M3. Today's sustainability problems tell us that humans are intrinsically worse than other species at sharing resources and using them sustainably.

Essential Questions

Q1. What are the causes and consequences of an observed behavior?

Q2. What are important conditions for humans to cooperate towards common goals?

Q3. What is the relationship between human behavior and human evolution?

Q4. What is the relationship between human behavior and sustainability?

Q5. What is the relationship between human evolution, behavior, and sustainability?

Design Concept

The following understandings, addressed misconceptions, essential questions, and skills form the foundation for the GlobalESD design concept.

Skills

S1. Students will be able to use Tinbergen's questions as a tool to explore complex causality in human behavioral ecology.

S2. Students will be able to construct causal maps to represent causal relationships between conditions, behaviors and other factors in the development of populations and social-ecological systems.

S3. Students will be able to represent the possible motivations and outcomes (costs and benefits) of human behaviors with the help of payoff matrices, and identify the scale of social interactions and possible social dilemmas within a population.

S4. Students will be able to compare principles across content (e.g. models, experiments, species, real world sustainability issues) with the help of analogy maps.

Lesson and Unit Design

With the guidance provided by our design concept and conceptual learning strategies, we develop lesson materials (→ see links on p. 95) and unit plans around these overarching understandings, essential questions, and skills. While you can use lessons individually in your classroom, ideally they are integrated into units spanning several lessons.

Therefore, we also develop guidance to help you sequence lessons into particular unit themes, each addressing a set of more specific concepts, understandings and essential questions, for example:

- A **Unit on Human Evolution** for teaching concepts and helping students develop the understandings and skills that characterize the field of human evolution (→ p. 97)
- A **Unit on Sustainability Science** for teaching concepts and helping students develop the understandings and skills that characterize the field of sustainability science (→ p. 99)

Importantly, while these units can be stand alone, there are large conceptual overlaps between them, and they can include some of the same lesson content.

Design Concept

The Global ESD design concept is complementary to many existing international standards and competency frameworks in ESD.

Education for Sustainable Development (ESD) aims to promote specific competencies in students and teachers. Different frameworks have been developed by different actors[1]. Broadly, the following overlapping areas of competence can be found across various frameworks:

Competencies for critical, networked and systems thinking: The ability to understand causal relationships, to analyze complex systems at multiple levels, to understand and evaluate multiple (possible, probable, and desirable) futures, to think across subject areas, and to apply what has been learned to similar and dissimilar contexts

Ethical reflection competencies: The ability to understand and reflect on the norms, values, and beliefs underlying our own actions and engage perspective taking in regards to the actions of others, to judge the consequences of actions, and to manage risks and changes through ethical reflection and discourse

Cooperation competencies: The ability to learn from others, to understand and respect the needs, perspectives and actions of others, to relate to them and to be sensitive to them, to deal with conflicts in a group and to enable collaborative and participatory problem solving

Action competencies: The ability to reflect on one's role in the local community and (global) society, and to motivate oneself to work towards common goals on multiple levels of society

What does the GlobalESD design concept contribute to achieving these existing learning objectives of ESD? These competencies require an understanding and awareness of the complex causes and consequences of human behaviors, including one's own behavior, from the level of the self to the level of global ecosystems and society. The GlobalESD approach therefore focuses on promoting the knowledge and skills underlying these competencies by framing core understandings, knowledge, and skills foundational for the ability to reflect on human behavior across contexts.

[1] e.g. Schreiber & Siege, 2015; UNECE, 2012; UNESCO, 2017

Content Anchors

Educational materials from various content anchors help us explore concepts and essential questions around human evolution, behavior, and sustainability

Cross-Species Comparisons

What can we learn from other species about human evolution, behavior and sustainability? Comparing the characteristics of humans and other species helps us understand the causes of human behavior and the principles of cooperation and sustainability.

Child Development

What can we learn from children about human evolution, behavior and sustainability? The development of social and cognitive skills in the course of a lifetime can help us understand the causes of human behavior and the origins of our everyday experience.

Ancient Ancestors

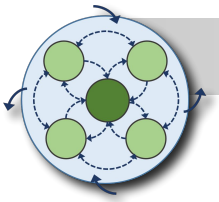
What can we learn from our ancestors about human evolution, behavior and sustainability? Exploring the characteristics of our ancestors, their living conditions, and the things they left behind, gives us clues about the importance of collaboration in our history and the causes of human behavior.

Cooperation Games

What can we learn from cooperation games about human evolution, behavior and sustainability? Cooperation games help us to investigate the causes and variations of human behavior in social situations.

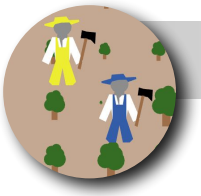
Content Anchors

Educational materials from various content anchors help us explore concepts and essential questions around human evolution, behavior, and sustainability



Governing the Commons

What can we learn from communities around the world about human evolution, behavior and sustainability? Exploring diverse sustainability dilemmas in the world helps us to identify the conditions and behaviors that play a role in the sustainable development of communities.



Computer Simulations

What can we learn from computer simulations about human evolution, behavior and sustainability? Computer simulations allow us to observe and investigate the influence of environmental conditions and behaviors on the evolutionary development of social-ecological systems.

Our Mind

What can we learn from our own thoughts and intuitions about human evolution, behavior and sustainability? Understanding the causes of our perceptions, intuitions, and beliefs helps us to engage them more flexibly, change perspective and learn from each other in regards to potential solutions to sustainability dilemmas.

Global Sustainability Goals

How can we translate insights about human behavior, cooperation, and causal relationships in social-ecological systems to local, regional, and global sustainability issues? How can we use these understandings to solve real world problems?

Cross-Species Comparisons

Humans seem to be a "strange" species....

Do other species do similar things? Why or why not?

Humans are living beings, mammals, primates, and apes. Like all other living beings, we need resources to survive, grow and produce offspring. Like all other living beings, we exist in interaction with our environment. Like many other social species, we depend on our social environment to survive and raise our offspring.

Social life, however, brings with it many challenges and potential for conflict: How should available resources be divided? Who should contribute how much to food provision, to the care of offspring, and to other vital functions? Who decides what should be done? How do we sustain ourselves, our offspring, our livable environment?

What can we learn from other organisms and groups of organisms about how to overcome these challenges of sustainable coexistence? How can we translate these insights to the challenges facing our environment and the global society?

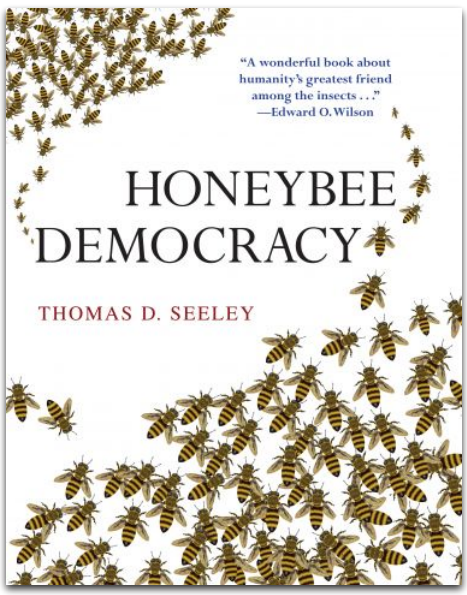
Cross-Species Comparisons

Honey bee “democracy”?

“We often think of democracy as an invention of mankind (….) But democracy needs to be understood more broadly, it is not just a form of government. We find it in a whole range of species. Look at a flock of birds that must agree on where to fly. Watch a group of geese decide when to set off in the morning. Ask a group of baboons what direction they want to go. I believe that in all these situations, there are elements of democracy, that is, whenever decisions are made by the group and not by a leader.”

Thomas Seeley (2015), own translation

Exploring **species in which individuals strongly depend on their group** for their survival provides a source of insights into the **causes of social behaviors** and their **functions for sustainable group living.**



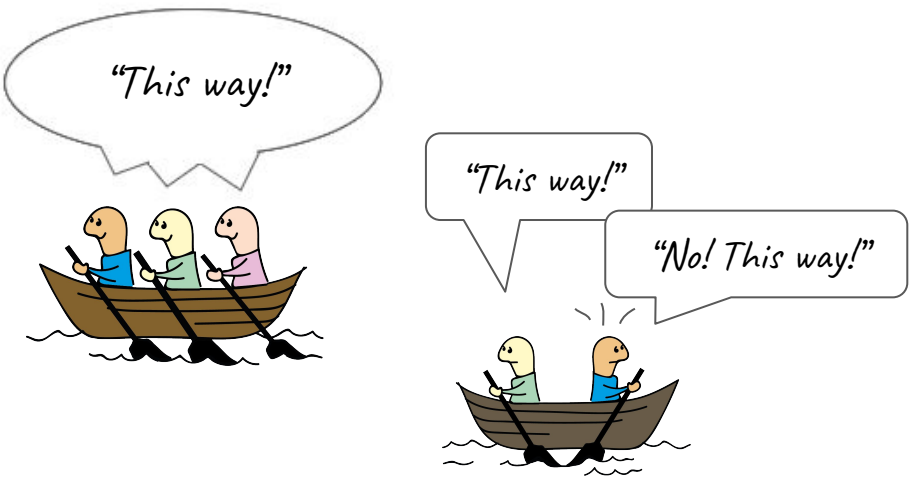
The biologist Thomas Seeley studies the behaviors of honeybees. Especially the decision-making process in a bee colony attracted his attention. How do thousands of bees manage to make the best possible decision about their future nesting site in an efficient way and without a leader?

→ **Misconception M1.** Phenomena in biology and society are predominantly caused by the intentions of single agents.

Cross-Species Comparisons

Honey bee “democracy”?

Due to the **division of labor** in a honeybee colony, all the bees of a colony are clearly sitting **in the same boat** (→ p. 3) - their survival and reproduction depend on the colony. No bee can, in the long run, survive and reproduce on its own. This fact, and the fact that honey bees have a 30-million-year history, seem to indicate that this species has evolved effective ways to regulate group life. This includes decision-making about the "future" of the bee colony, even if individual bees can not actually think in terms of their preferred future.



When everyone is in the same boat, it is important to decide the direction together.

“For the members of a decision-making group to work together productively, they must have a fair amount of alignment of interests so that they are inclined to form a cooperative and cohesive unit. (...) The bees also demonstrate that a democratic group can function perfectly well without a leader if the group’s members agree on the problems they face and on the protocol they will use to make their decisions.”

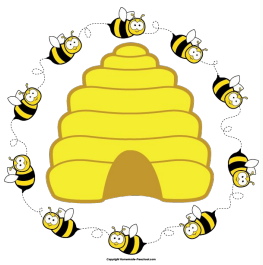
Thomas Seeley (2010)

Cross-Species Comparisons

Honey bee “democracy”?

“The fundamental decision-making dilemma for groups is how to turn individual preferences for different outcomes into a single choice for the group as a whole. (...) [T]he study of group decision making by honey bees might help human groups achieve collective intelligence and thus avoid collective folly. Good group decisions, the bees show us, can be fostered by endowing a group with three key habits: structuring each deliberation as an open competition of ideas, promoting diversity of knowledge and independence of opinions among a group’s members and aggregating the opinions in a way that meets time constraints yet wisely exploits the breadth of knowledge within the group.”

Seeley et al. (2006)



Principles for democratic decision-making:

- Common goal(s) or shared interests
- Low influence of a central leader
- Diverse and independent experiences and perspectives
- Open exchange of views
- Consensus building

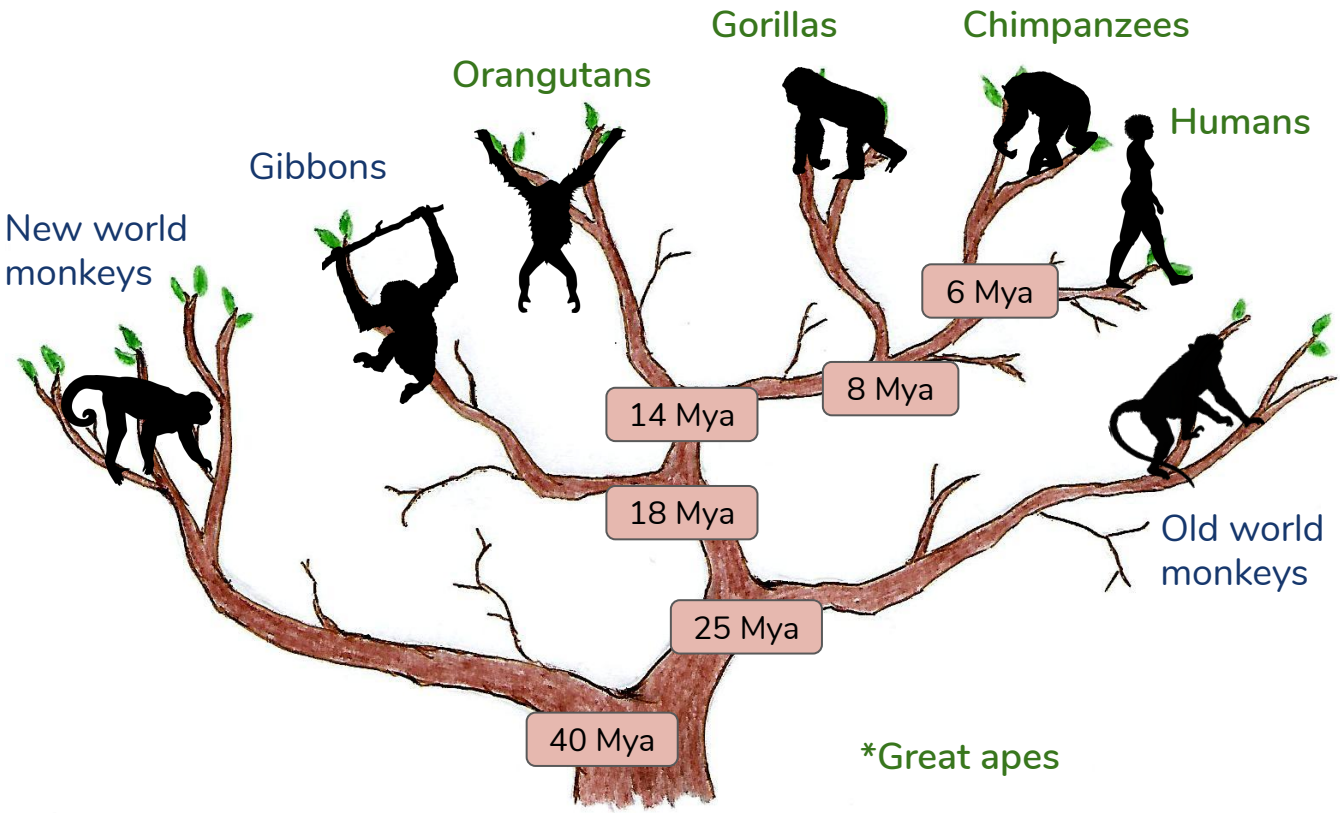
Biologists find similar principles in the organization and decision-making processes of ants and in our brains - that is, whenever populations of individuals (bees, ants, cells) have to survive together, and must therefore “decide the direction" together. It is no coincidence then, that these principles are instantiated in one way or another in a well-functioning human democracy.

Cross-Species Comparisons

Humans are primates

We are primates and not very closely related to honeybees. With bees, we primates have in common that we live in social groups. But we primates have a much more complex and flexible social behavior. We have various forms of social life: some of us live in large groups, others in small groups. Unlike bees, we primates have complex emotions that shape our social behavior.

How are we humans different and similar to other primate species, and why? What similarities are the result of our common descent, and what similarities are the result of similar challenges in the course of species-specific evolutionary history?



Evolutionary anthropologists study the similarities and differences in the characteristics of humans and our near and distant primate relatives.

Cross-Species Comparisons

Humans are great apes

We apes have good abilities to understand our physical environment: we have good spatial perception, understand cause-and-effect relationships, we handle and use objects as tools in many ways, we can understand some of the mental states and intentions of others, and we recognize ourselves in the mirror.

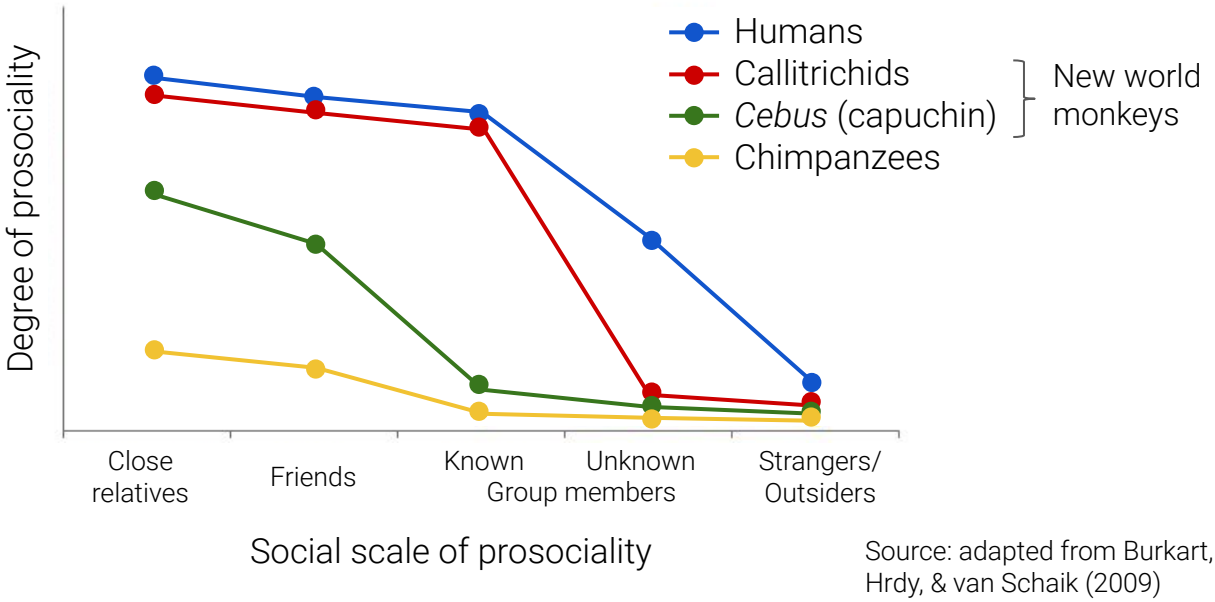
But why have we become the ape species whose behaviors and technologies are changing the entire planet today, who work together in large groups in order to change those effects, in order to send one of us to the moon, in order to exercise aggression towards other groups in complex ways, to create art and music, or to understand our own evolution? Why is a "Planet of the Apes" fiction when it comes to chimpanzees, gorillas and orangutans, but is a reality when it comes to our species of ape?

→ **U1.** Our everyday behaviors and experiences have many causes, some of which go all the way back to their evolutionary origins.

Cross-Species Comparisons

Humans are a highly *prosocial* type of primate

For biologists, **prosociality** refers to behaviors that benefit others. Spontaneous prosociality is the ability and motivation to be friendly, to tolerate others' presence, or to share things and information with others, without "threat" or "rational calculation," but rather spontaneously or voluntarily. Spontaneous prosociality is thus not tied to "intelligence" or certain cognitive abilities, but to a particular **social temperament**. When biologists compare the extent of prosociality in different animal species, they find that those species that live in groups and collaboratively raise their offspring, have a pronounced prosocial temperament. Apparently, a prosocial temperament has an important function in sustaining groups in which everyone is "**in the same boat**".



Source: adapted from Burkart, Hrdy, & van Schaik (2009)

It appears that humans have a strong prosocial motivation compared to other primates, even towards unknown others.

Cross-Species Comparisons

"Here's a headline most people wouldn't bat an eye at: 'Four people were murdered in New York City today', we almost expect it. But here's a headline we're never going to see: '8,299,996 people got along in New York City today'."

Agustín Fuentes (2014)

"Humans are often eager to understand others, to be understood, and to cooperate. Passengers crowded together on an aircraft are just one example of how empathy and intersubjectivity are routinely brought to play in human interactions. It happens so often that we take the resulting accommodations for granted. But just imagine if, instead of humans being crammed and annoyed aboard this airplane, if it were some other species of ape. (...)

What if I were travelling with a planeload of chimpanzees? Any one of us would be lucky to disembark with all ten fingers and toes still attached (...). Bloody earlobes and other appendages would litter the aisles. Compressing so many highly impulsive strangers into a tight space would be a recipe for mayhem."

Sarah Hrdy (2009), p.2-3

Cross-Species Comparisons

So while we share certain mental abilities with chimpanzees and other apes, in our prosocial temperament we are more like to our more distant relatives. Even in our ability to make joint decisions in a democratic way, we seem to be more similar to honeybees than other great apes (even though the mechanisms of decision-making in bees and humans may look quite different).

"Humans are 90% chimp, and 10% bee".

Jonathan Haidt (2012)

Some anthropologists suggest that the interplay between the cognitive abilities that we have inherited from our common ancestors with the other apes, and a high prosocial temperament that appears to have evolved throughout our own evolutionary history (→ p. 35 ff.), has led to the particular capabilities of our species: the ability to work together, to communicate, to learn from each other, and to invent new things together.

"Our hypothesis is that while chimpanzees and, perhaps, all great apes may have many of the relevant cognitive preconditions for uniquely human cognition to evolve, they lack the motivational preconditions. In humans alone, these two components have come together."

Burkart, Hrdy & van Schaik (2009)

Cross-Species Comparisons

"We think [apes are] especially good at cognizing things about the physical world, understanding space and causal relations like when using tools, what causes something to move etc. They're very good at that and basically they're not that different from human children.

What makes us really different is our ability to put our heads together and to do things that neither one of us could do alone, to create new resources that neither one of us could create alone. It's really all about communicating and collaborating and working together."

Michael Tomasello (2014)
Former Co-Director,
Max Planck Institute for Evolutionary Anthropology

Our prosocial attitude towards our conspecifics depends very much on the extent to which we count strangers as being within "our group" (→ p. 25). **As long as we have a common identity**, or our perception tells us that we are **"all in the same boat"**, it is relatively easy for us to get along with everyone in our "boat". We may, however, show a completely different set of primate behaviors if our perception tells us that we are dealing with competitors.

→ Q2. What are important conditions for humans to cooperate towards common goals?

Child Development

Questions about human nature have occupied philosophers for more than two millennia: are we born innocent angels, and growing up in society turns our nature into selfishness and deceit? Are we by nature selfish and violent, and only by education we instill a sense of justice, empathy and morality into our children?

What are the characteristics and behaviors that characterize the *Homo sapiens* species, and what are the consequences of education and growing up in a particular social environment?

Anthropologists who ask these questions are particularly interested in the **development of children in different cultures**. All humans come into the world as a baby, and we are born into deeply social environments.

By observing the skills and behaviors of growing children, researchers can gain insights into the evolution of our species: children show us what qualities humans exhibit before we are strongly influenced by our social and cultural environment, and to what extent the sociocultural environment and individual experiences shape the development of our perceptions and behaviors.

"Studying early childhood means learning to understand how humans have become who they are - every individual as well as all of us as a species. This understanding creates perspectives. Perspectives on the fundamental commonalities of all humans as well as the differences between individuals and cultures, on equal opportunities and health and the things that impede them"

Prof. Dr. Daniel Haun, Director,
Leipzig Research Center for Early Child Development
& Department of Comparative Cultural Psychology
Max Planck Institute for Evolutionary Anthropology

Child Development

Our “genetic starter kit”[1] for social cognition and learning

- As soon as we are born into the world, and perhaps even before, our perception is focused on our social environment: faces, voices, the emotions and actions of the people around us attract our particular attention.
- Around the age of three months, we can already perceive and distinguish whether someone behaves "good" and helpful or "bad" towards others, and we prefer the "good ones."
- Around the age of nine months, we begin to communicate in a special way with the people around us: through the use of pointing and eye contact, we discover the world together, focus our attention on common points of interest, engage in shared activities, and construct sounds together into symbols that represent things in the world. We begin to favor those who resemble us in their preferences, language and appearance.
- In the second year of life we develop the ability to perceive the needs and preferences of others, to distinguish them from our own, and to spontaneously share with them. We already have a sense of the fair distribution of things. Words and other symbols are becoming more and more important and are increasingly shaping our experience. We start to recognize ourselves in the mirror as “me”.
- In the fourth year of life, we develop the ability to distinguish our present needs and mental states from those that we had in the past or might have in the future. We begin to use memories to develop our own conscious identity and life story.
- From the age of five, we begin to also align our behavior with social norms and control our impulsive responses: we have learned from others what is "good," "right," "normal," and what is "bad," "wrong” and “unnormal”, and we automatically incorporate these rules into our perceptions, thoughts, identities, and behaviors.

[1] *sensu* Heyes (2018)

Child Development

"[Our research] suggests that from very early in [development] young children have a biological predisposition to help others achieve their goals, to share resources with others and to inform others of things helpfully. Humans' nearest primate relatives, such as chimpanzees, engage in some but not all of these behaviors: they help others instrumentally, but they are not so inclined to share resources altruistically and they do not inform others of things helpfully."

Warneken & Tomasello (2009)

Recent studies[1] demonstrate that, through the early development of these social and cognitive abilities, children as young as six are already able to use a shared, limited resource by talking to each other, building a common identity, establishing common rules, and sharing the resource fairly. They can prevent the "tragedy of the commons" (→ p. 2) without anyone telling them what to do, and even if they have never met before.

Apparently, it is generally easier for us humans than for our closest relatives to work together with our conspecifics, to learn from one another, and to share things - even if these behaviors may not be expressed in all circumstances.

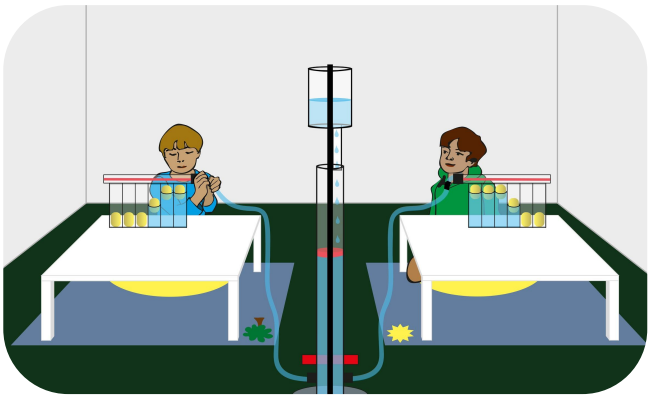


Image inspired by: Koomen & Herrmann (2018a)

→ U2. Humans have been shaped by natural selection and cultural evolution to have an elaborated capacity to cooperate beyond kin.

[1] Koomen & Herrmann (2018a,b)

Child Development

Extended childhood and education characterize our species

> *"[O]ur unique evolutionary trick, our central adaptation, our greatest weapon in the struggle for survival, is precisely our dazzling ability to learn when we are babies and to teach when we are grown-ups."*
>
> Gopnik, Meltzoff & Kuhl (2000), p. 8

In the development of all these human abilities - empathy, sense of fairness, cooperation, learning and teaching, language and symbols, thought, adopting social norms, control of our behavior - the genes we come into the world with are crucial, but they are just a "starter kit". The individual development of human beings is particularly tied to growing up in a social environment and therefore can only be understood in the context of the evolution of our culture.

> *"The way children have learned and been taught during millions of years has had a direct impact on how we as humans act and think. Homo sapiens cannot avoid learning and teaching. We do it by reflex. Even young children have a natural capability to teach."*
>
> Högberg (2015), p. 118

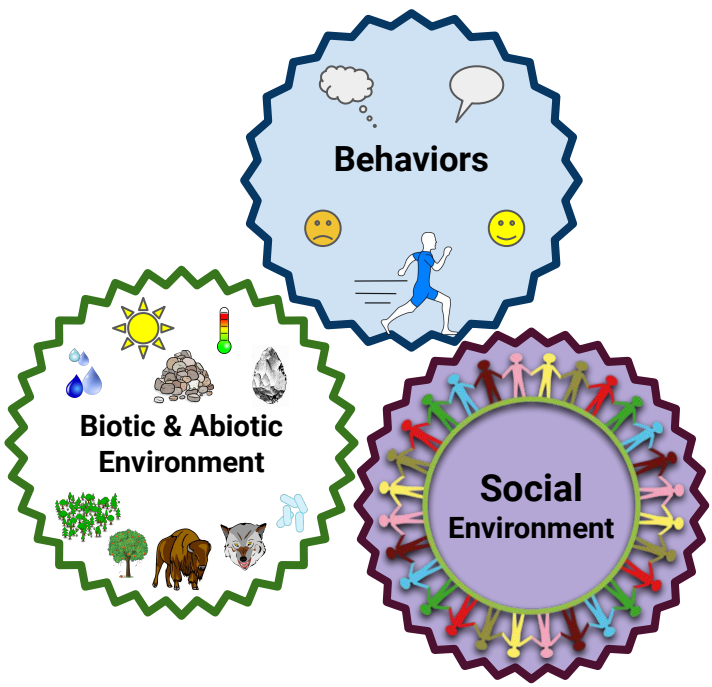
> *"People often seem to split the human mind into two parts: a "natural" neurologically determined part that is shaped by evolution and a "cultural" socially determined part that is shaped by learning. Studying babies makes us realize how deeply misguided these oppositions are. (...) For human beings, nurture* ***is*** *our nature. The capacity for culture is part of our biology, and the drive to learn is our most important and central instinct. (...)"*
>
> Gopnik, Meltzoff & Kuhl (2000), p. 7, 8

Child Development

"If you raised a child on a desert island with no social context, no teaching, not any contact to humans, their intelligence as an adult would be very similar to that of other apes. It'd be a little bit different, but [human children] have evolved to learn from others, and to communicate with others, and to collaborate with others. And if there was no one there, and no culture and no tools and no language, then that naturally human intelligence just wouldn't develop.

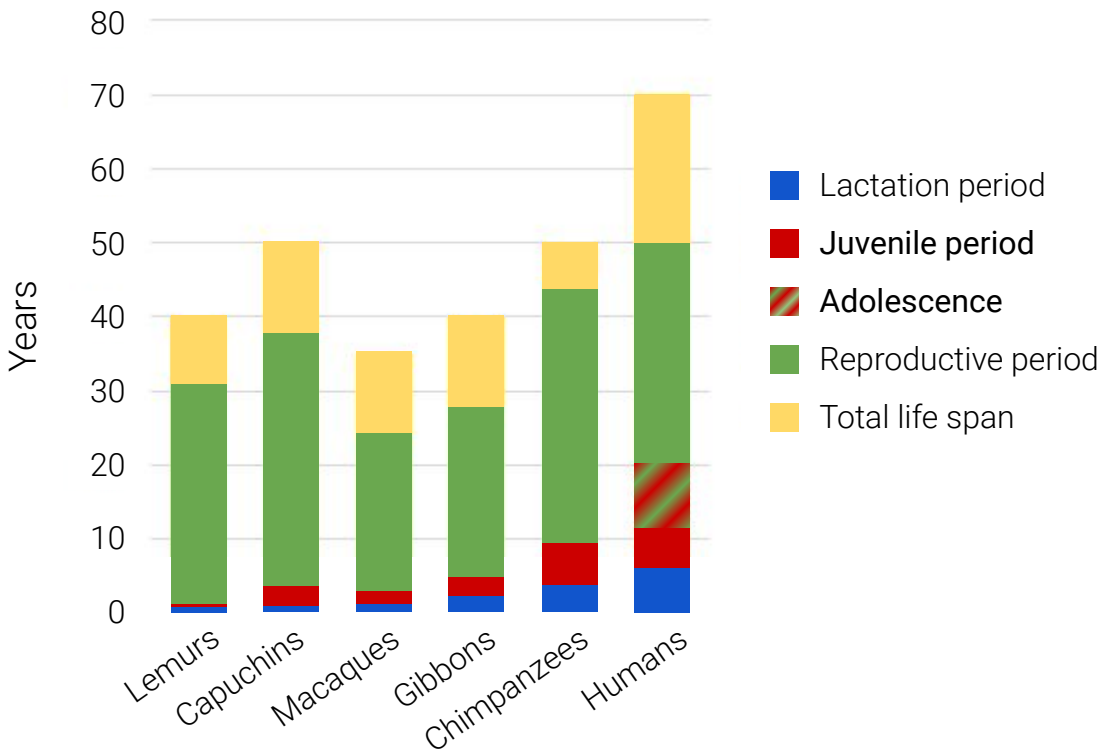
Fish are born expecting water, they've got fins and gills, and humans are born expecting culture."

Dr. Michael Tomasello (2014)
Former Director, Max Planck Institute for Evolutionary Anthropology



Child Development

Compared to other primates, we humans also invest a lot in our offspring - for a very long time, children depend on the adults around them and they are given time to learn. And not only the parents, but many other people in our environment take care of us, teach us things, and provide for us. Childhood and adolescence, social learning and teaching seem to play an important role in our species.



Compared to other primates, we humans have a very long childhood, and have evolved a new phase of life: adolescence. Source: adapted from Zimmerman & Radespiel (2007, p. 1166)

The importance of childhood, social learning and teaching in the evolution of our species provides a perspective on why *education* continues to play a central role in the future development of our species. What children learn from their social environment today may also shape the future of our species.

Ancient Ancestors

"Nothing in biology makes sense except in the light of evolution."

Theodosius Dobzhansky (1973)

How can we explain the traits and behaviors that seem to differentiate our species from others (→ p. 19 ff.), and which we humans already show in early development (→ p. 29 ff.)?

Many anthropologists, psychologists, behavioral scientists and sustainability scientists are concerned with the evolutionary history of our species, because we can only understand our present-day behaviors, experiences and cultures against the background of their evolution. We can also better tackle today's challenges to human well-being, peaceful coexistence, international cooperation, and sustainable resource use if we compare our living conditions with those of our ancestors, and if we know what factors contributed to the survival of our ancestors.

Who were our ancestors? How did they live? Were they exposed to similar challenges as we are today? How did they master these challenges? What have we inherited from them, and why?

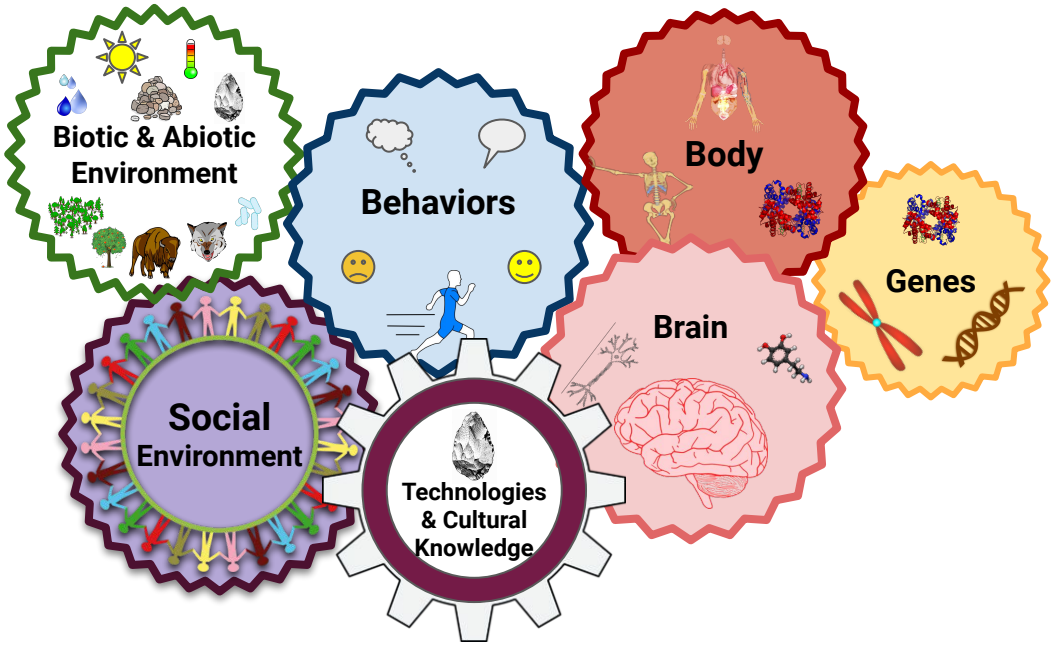
"[N]othing in human affairs—including much of economic and sociopolitical behavior—makes sense except in the light of evolution."

Rees (2010)

Ancient Ancestors

Evolution is the change of characteristics within populations

This change is the result of interactions between the abiotic, biotic and social environments, behaviors, bodies, brains, technologies, cultures, and genes of organisms. These interactions shape the evolution and development of our traits and our world.



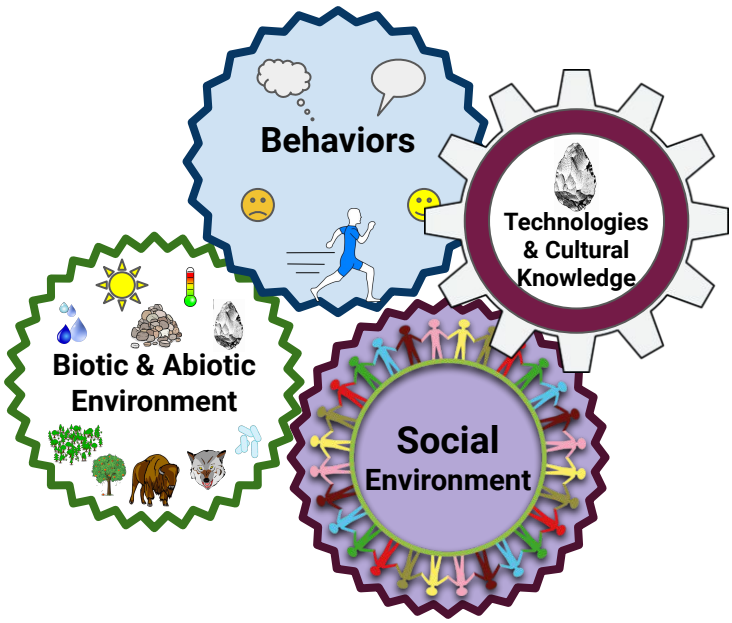
Different scientists define and study evolution in different ways. Some are primarily interested in the change of genotypes and gene frequencies in a population. Others look at change in genes *and* change in all the other things (phenotypes, e.g. behaviors, brains, bodies, social organisation, technologies, culture, and environmental features) in a population. Depending on what we look at, there can be different ways that traits get inherited - for example, through the inheritance of genes to offspring, or through imitation of behaviors. There can also be different ways how new traits appear in the population, and different ways how traits become more or less common in a population. If we want to understand the evolution of human behaviors and cultures, it makes sense to look at many different phenotypes and their interactions, and consider all of the possible mechanisms of their variation, selection, and inheritance.

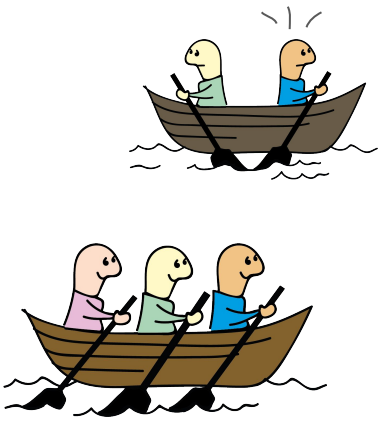
Ancient Ancestors

	Evolution of Genotypes	Evolution of Phenotypes
What changes are focused on?	The frequency of genes / alleles involved in the expression of a trait	The frequency of traits: e.g. genes, body features, brain features, behaviors, cognitive traits, social organisation, technologies and structures created by living things
What are the causes of new **variation** in traits?	Random mutations and recombination of genes	**Depending on the trait:** mutation and recombination (of genes); trial-and-error learning, inventiveness, recombination of ideas; behavior change as response to novel environment
How does the "**selection**" of traits occur?	The trait (gene/allele) increases the chances of reproduction under the given environmental conditions	**Depending on the trait:** reproductive success; conditioning, learning or inner preferences motivate individuals (consciously or unconsciously) to learn, imitate, rebuild, use, or teach others
How is the trait **inherited** or **transmitted** within the population?	Through biological reproduction and inheritance of genetic material to offspring	**Depending on the trait:** genetic inheritance; social learning / teaching (passing on to both offspring and others); accumulation of created forms, patterns, and structures that persist in the environment over time, and interactions among any of these factors
What is the meaning of the term "fitness"?	Number of surviving offspring; the increasing frequency of the gene/allele in the population.	**Depending on the trait:** Number of imitators or surviving offspring; the increasing frequency of the trait, pattern, or technology in the population.
Can organisms adapt in the course of a lifetime?	No, because the genome in the germline cells of an organism does not change in the course of a lifetime. Only populations can adapt through natural selection.	Yes, because, many organisms can change their behaviors, thoughts, or environments in adaptive ways. *Some* scientists even further view organisms themselves as *populations of cells and trait variants* which change and adapt (or not) within the lifetime of the individual. Others disagree this should be considered 'evolution'.

Ancient Ancestors

It is not easy to draw conclusions about the living conditions and behaviors of our ancient ancestors merely from isolated fossils and archeological findings. Yet, what is certain is that there have been many challenges to survival and livelihood throughout our evolutionary history. The natural and social environmental conditions of our ancestors became increasingly such that individuals were dependent on the group for their survival - they were all **sitting in one boat** (→ p. 3). Those groups in which individuals were able to work together, learn from each other, pass on vital technologies to the next generation, share resources within the group, avoid conflicts, or solve them as efficiently as possible, had higher chances of survival and reproduction than others. These circumstances have shaped us as a species. Many of **our behaviors observable today** can only be explained by the fact that they have **evolved as an adaptation to group living**.

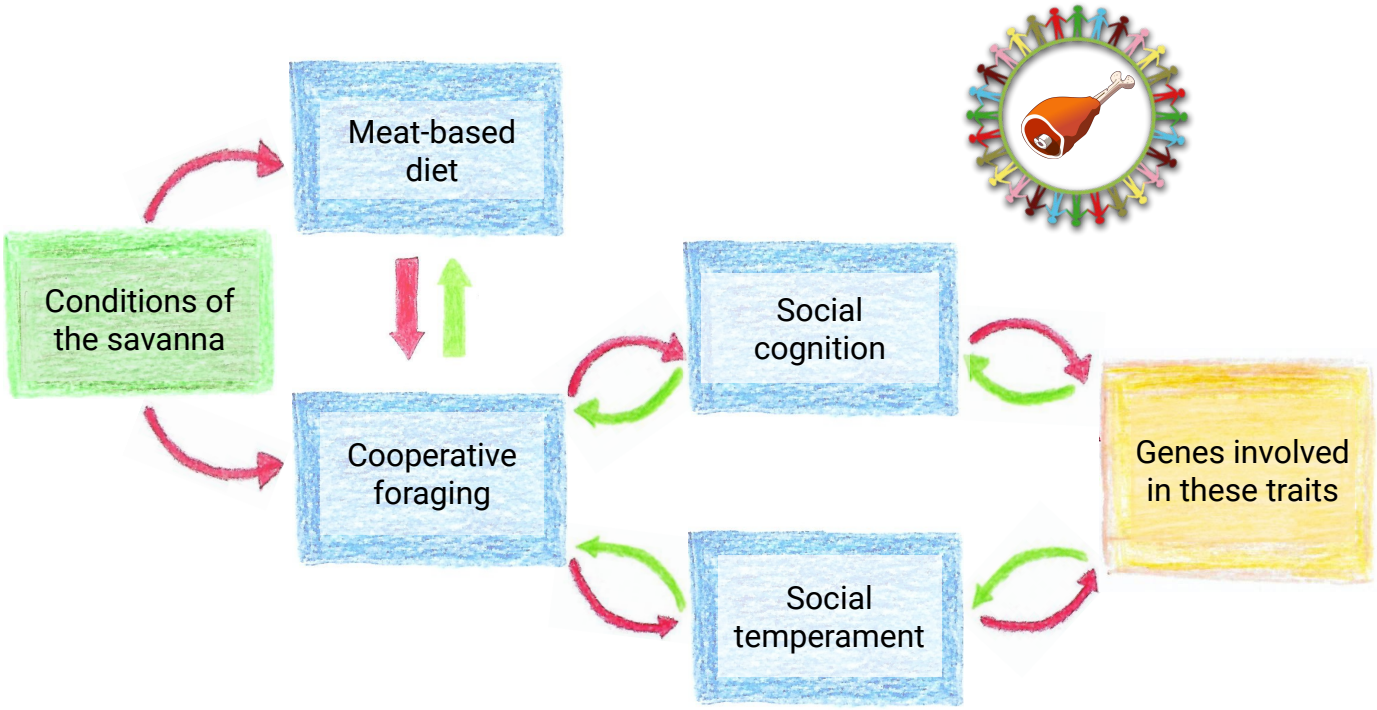




→ U2. Humans have been shaped by natural selection and cultural evolution to have an elaborated capacity to cooperate beyond kin.

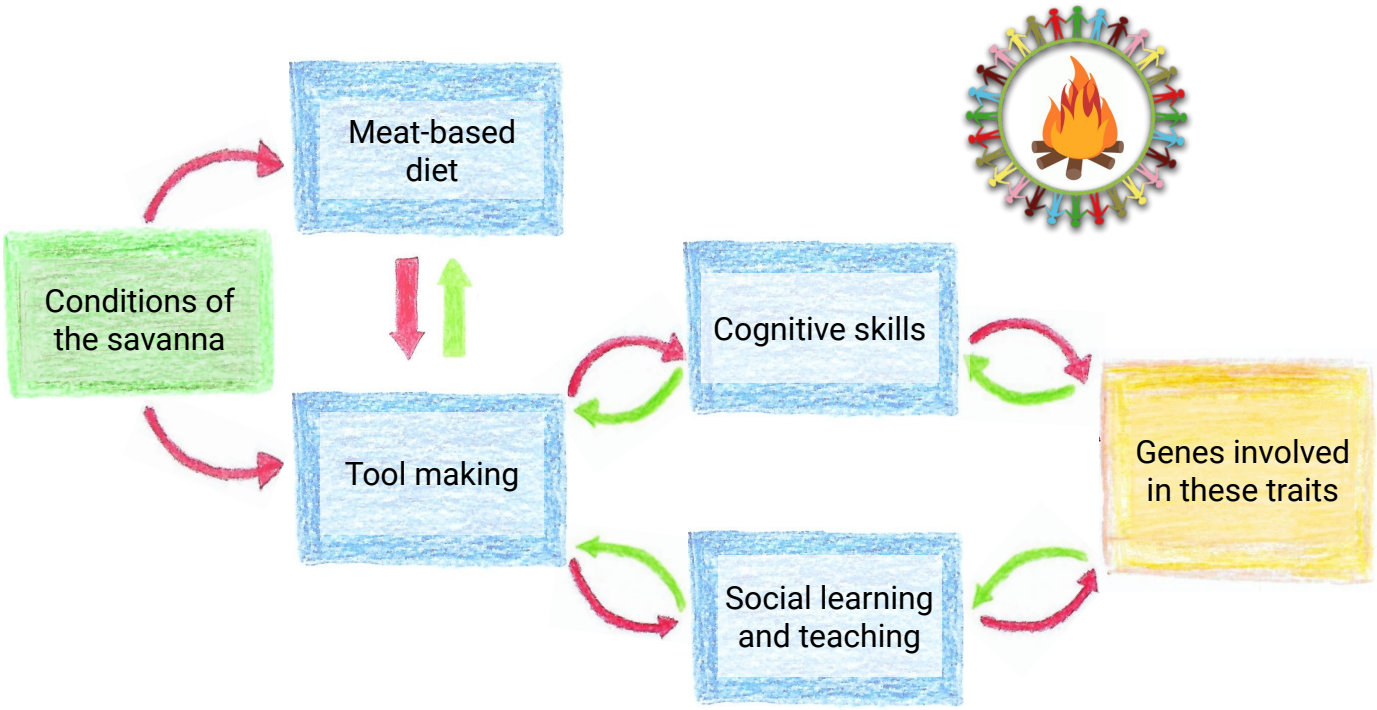
Ancient Ancestors

To compete with predators as primates is not that easy. Those who were able to work together in food procurement, coordinating their activities, in order to achieve a common goal, and then divide the food in the group, had greater chances of survival and reproduction than others.



Ancient Ancestors

Making a hand-axe, fire and other complex tools is not that easy. Those who had good skills and motivations for social learning and teaching were better able to learn this toolmaking from others and pass it on to others.



Ancient Ancestors

Thus evolutionary anthropologists conclude from the observations of our close and distant relatives (→ p. 19 ff.) , from the development of children (→ p. 29 ff.), and from the evidence of the past that **we seem to have inherited from our ancestors special social skills** - skills for social perception, the imitation of our fellow humans, social learning, rapid internalization of social norms; motivation for teaching and communicating information to others; motivation for sharing resources within the group and collaborating towards common goals; skills and motivation for avoiding and resolving conflicts; social emotions such as empathy, envy, anger, guilt, shame; moral intuitions such as sense of fairness, compassion and autonomy; a prosocial temperament and a need to be with others.

Of course, we also inherited the **capacity for aggressive and selfish behavior** from our ancestors. Because these behaviors were useful in situations in which our ancestors did **not sit in the same boat with others**: situations where competition within or between groups became the dominant kind of social interaction.

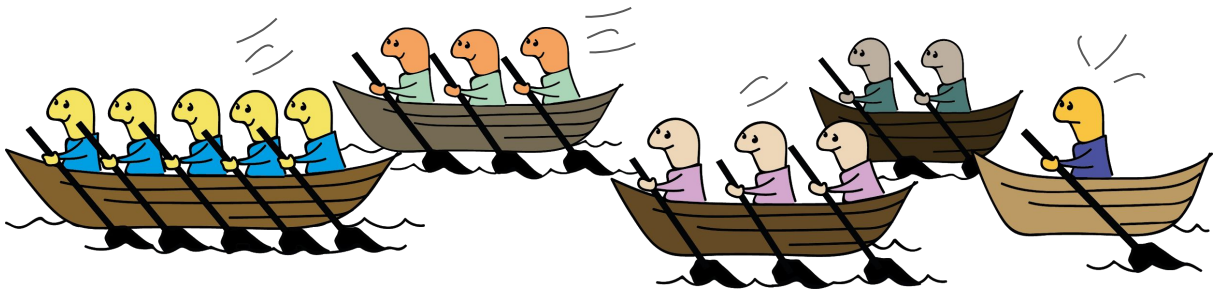
→ **U1.** Our everyday behaviors and experiences have many causes, some of which go all the way back to their evolutionary origins.

Ancient Ancestors

From Sociality to *Ultrasociality*

The evolution and history of our species is not only characterized by living in isolated and small hunter-gatherer groups, in which everyone knows each other and has personal contact. Our human traits have also been shaped by competition and cooperation between groups, and finally by the fusion into ever larger groups.

When groups meet and compete with each other, e.g. because certain resources are limited, those who can unite into one entity and cooperate *within* the group will be at an advantage.



Competition between groups exists in many species. However, in our species this competition apparently lead to the fact that, within a relatively short time in evolutionary terms, we were able to “merge our boats” with those of other groups, into ever larger groups that “steered a boat together”.

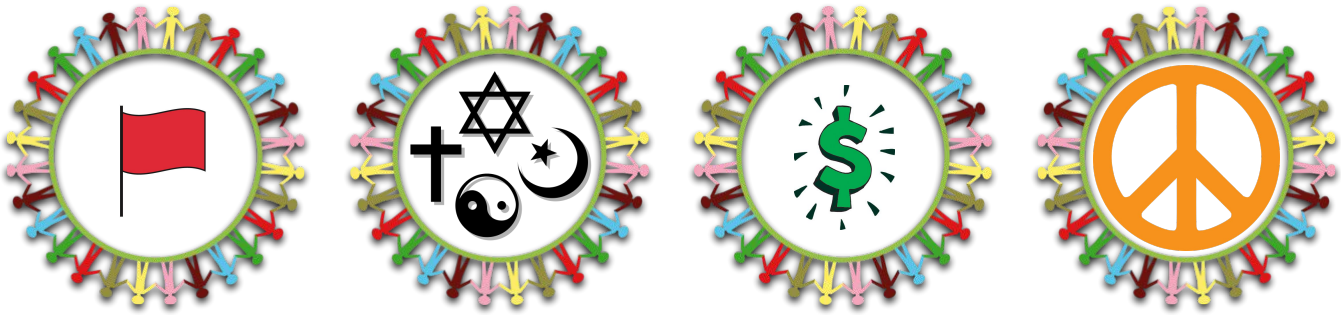
The fact that cohesion is beneficial in competition with others can be found in everyday proverbs and images of different cultures. "Together we are strong" - we humans seem to have an intuitive sense of it.

“Sticks in a bundle are unbreakable.”

Kenyan proverb

Ancient Ancestors

This association into ever larger groups was made possible in our species by the ability for language and symbolic thinking. This ability allowed our ancestors to build a common identity and cooperate with others, even if they would never meet them in person.



So on the one hand, the history of humanity is characterized by conflict between groups, but on the other hand, in the long run this resulted in the joining of groups of people into ever larger communities as we recognized and acted on our social interdependencies.

The fact that today many people of different backgrounds live together, and work together for global goals, universal human rights and the well-being of humans and other creature they will never encounter, is the result of this development.

However, due to the history of group competition, we also have a **tendency to quickly divide our social environment into groups** - "Us" and "Them". We automatically and relatively unconsciously recognize similarities and differences in our behavior, appearance, language, beliefs and symbolic markings. Under certain conditions, especially when there is a sense that others are posing a "danger" or “threat”, this perception may encourage aggression towards other groups.

Ancient Ancestors

"The capacity for symbolic thinking was the last great evolutionary innovation that made possible human ultrasociality. People now did not need to know personally another individual in order to determine whether to cooperate with him, or treat him as an enemy. (...) Symbolic demarcation of the group made possible cooperating with strangers who were clearly marked as "one of us." Symbols made it possible to identify with very large groups of "us," groups that included many more people than the small circle any individual person could meet and get to know personally. In other words, the evolution of symbolic thinking enabled defining as "us" a group of any size."

"Large nations of tens of millions of people did not, of course, arise in one fell swoop. The process was gradual and happened in stages. Several villages, threatened by a powerful enemy, could unite in a tribe and invent symbolic ways to mark and emphasize their union. In the next stage, several tribes could unite in a region-sized society; then regional societies into nations, and those, finally into supranational unions, such as large empires and whole civilizations. At each step, new symbols are invented to demarcate ethnic boundaries, or old symbols are stretched to encompass the larger society."

"As a new level of social complexity arose, the lower levels of organization were not completely eroded. As a result, people in general have coexisting identities, nested within each other. They can feel attachment and loyalty to their native town, their region, their country, and even to supranational organizations. The degree of identification with, and loyalty felt toward, an identity at any particular level can vary a lot."

Peter Turchin (2006)

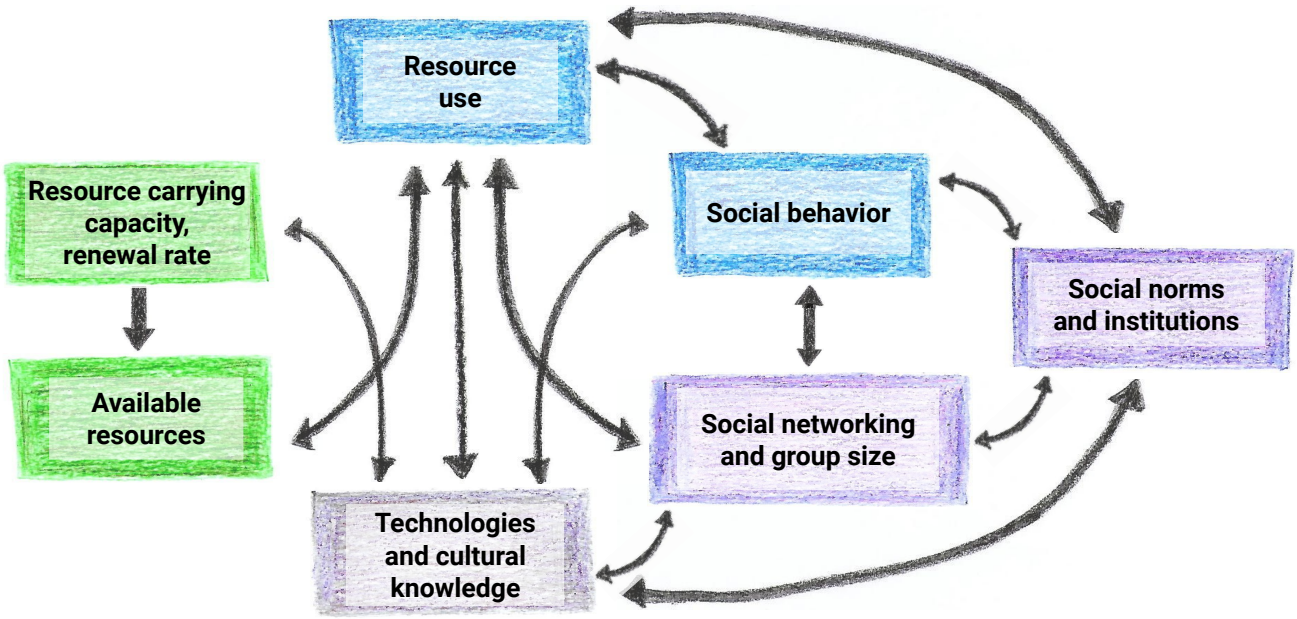
→ Q2. What are important conditions for humans to cooperate towards common goals?

Ancient Ancestors

Cultural evolution of technologies and institutions

The evolved social and cognitive capabilities of our species enabled **cultural evolution**: the cultures of the world adapted to their respective environmental conditions by developing their own **technologies** and **norms**. This enabled our species to populate virtually all the world's ecosystems. Our social and cognitive skills also allowed social networking to ever larger groups. **New institutions and norms** had to be developed to govern life in these groups. However, over the long term some norms and institutions work better than others to manage the use of shared resources, and to resolve conflicts within and between groups efficiently.

Increased **networking between people** accelerated cultural evolution - new technologies, new knowledge, and new ways to more efficiently extract natural resources. Often, this was accompanied by an **increase in our population size**. But **the more efficient the technologies** became in exploiting natural resources, and the more people benefited from them, the more powerful the **consequences of human behavior** became on our social and natural environment.



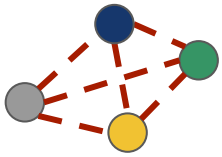
Cooperation Games

Games offer further helpful analogies that help us think about how certain situations affect relationships and interactions between people (→ cf. p. 3).

- **In some games you only play "against yourself"**: You're sitting in your own boat, and it does not really matter how good others are in the game. You want to beat your own record, solve a tricky puzzle, be better than last time, reach the next level.

- **Some games are a "team sport"**: all players of the team are in the same boat. "My victory" is "Our victory". They compete against other teams. The team that can work together better will have the long-term advantage. Competition within the team can jeopardize cooperation and be detrimental to the whole team.

- **In other games everyone plays against everyone**: Everyone is sitting in their own boat and we are rowing, running, swimming, thinking, battling against each other. "My profit" is "your loss", "my victory" is "your defeat". The strongest, fastest, or the one with the best strategy wins.



It is not hard to predict how players should interact with each other in these different game variants - with whom they should cooperate and with whom they should compete. **However, it is not so clear in other games.**

Game network graphics based on Peoples et al. (2017)

Cooperation Games

Also in life, we all play a kind of "game" - because we live in social groups, sometimes belong to different "teams", sometimes see each other as competitors, or sometimes play "against ourselves". There are different things to "win" or "lose": health, a long life, relationships, friends, enemies, family, money, success, reputation, "happiness". But in life, it is often not very clearly defined what kind of game we are in - whether, for example, everyone is in the same boat and should cooperate, or whether everyone is playing against each other. In such situations, it depends more on how people themselves perceive the situation, how they assess the behavior of others, and how they react to the behavior of others. The rules of the game arise from the behavior of the players in the course of the game!

Game theory is an important method of behavioral research, with the aim of investigating the causes and manifestations of human social behavior in such situations. As with other games, scientists come up with situations that best reflect specific aspects of the situations and challenges of real life in social groups.

How will humans behave in these situations? Will everyone behave as if it's a team sport or will they see themselves as competitors? What do they actually want to win? Are humans interested in money, reputation, a good feeling, a fair game? How are the behaviors of people of different ages and socio-economic or cultural backgrounds similar and different? Game theory experiments provide **insights into the evolutionary, historic, developmental, and immediate causes and consequences of human social behavior.**

The research questions and methods of game theory also help students and teachers to reflect on human behavior in everyday situations, and to translate insights to real-world challenges in communities.

Cooperation Games

Do people voluntarily share with a stranger?

In two standard games in game theory, **the Dictator game** and **the Ultimatum game**, people receive a certain amount of money (or some other attractive resource) - would they give away some of that unexpected win to a stranger? What kind of behavior do we expect from people in such a situation? Will they want to keep everything to themselves, or will they be willing to hand over a part to the stranger? Why, or why not? How will young children behave? Will all people, regardless of their background, behave in a similar way? Why, or why not? Will other primates behave similarly? Why, or why not? What happens if the partner can refuse the offered sum, and in this case both leave empty-handed? How can we transfer the conditions and observed behaviors in this game to real life?

Results from these experiments let us reflect on the causes and facets of human **altruism** and our **sense of fairness**, as well as the role of **social emotions** and **social norms** in our behavior.

Cooperation Games

Do people voluntarily contribute to maintaining a common resource?

Another standard experiment in game theory, the **public goods game**, reflects the challenges that arise when a group of people has to maintain a common resource (→ p. 2). In such a situation, everyone is in the same boat, but selfish behavior can be beneficial to the individual.

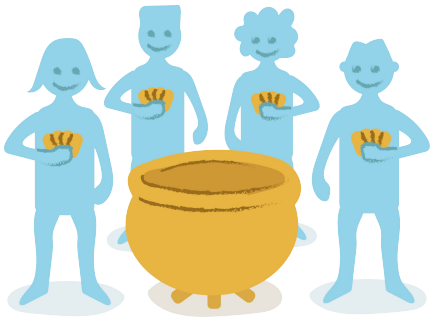
For the maintenance of common resources, it is best that everyone fully contributes. For the individual, however, it pays to contribute less than others. But if nobody contributes, everyone in the group loses out.

How will people behave in such a situation, particularly if their behavior is not visible to others in the group? Will all people, regardless of their origin, behave in a similar way? Why, why not? What role do **emotions and beliefs** play in their behavior? What happens if we change the rules and conditions of the game? How do **anonymity** or **communication** influence the outcomes? **What rules and conditions of the game motivate people to act in the common good?** What rules and conditions of the game prevent people from acting in the common good?

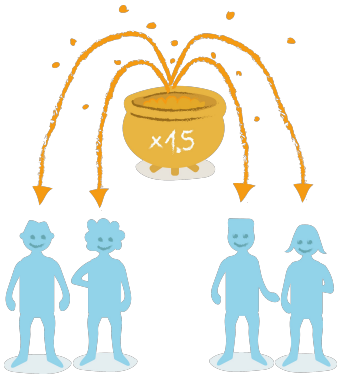
How can we transfer the rules and conditions and human behaviors observed in different versions of the public goods game to concrete problems of sustainable resource use?

→ Q2. What are important conditions for humans to cooperate towards common goals?

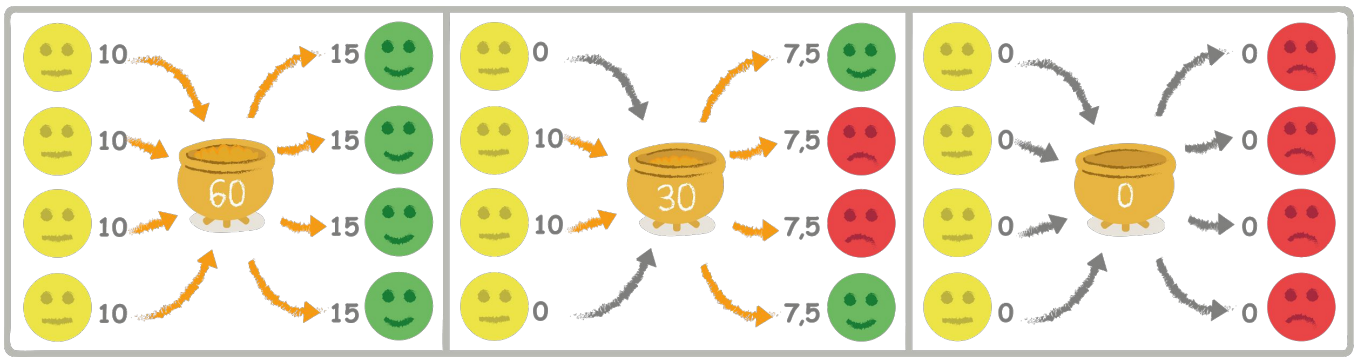
Cooperation Games



In the public goods game, each member of a group receives a sum of money. Each one can deposit some of their money in a common "pool" or bank.



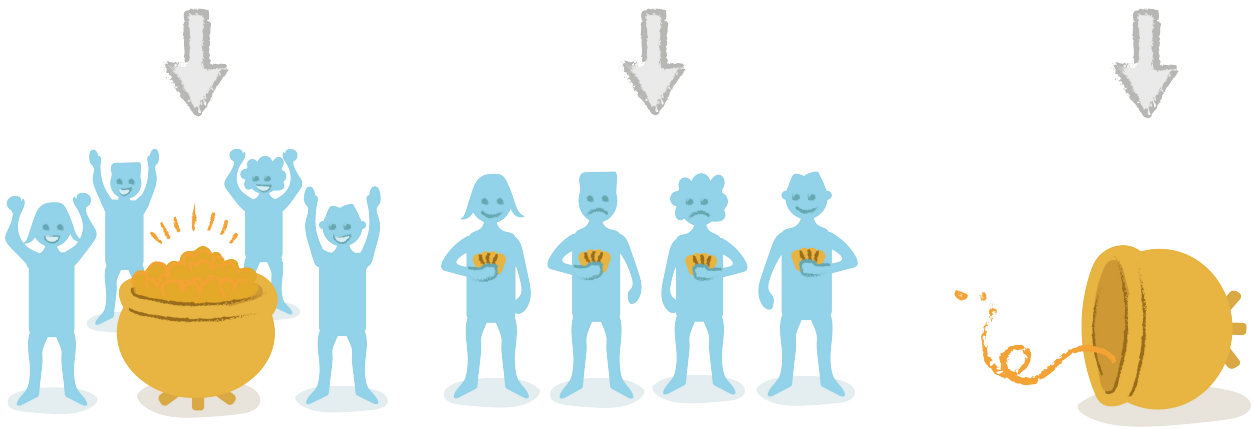
The total amount in the common pool is increased (e.g. by 50 %) and is then paid out equally to all members, no matter how much each one has deposited.



For all players, it is best if everyone contributes their entire sum, because then everyone gets paid out the most.

For the individual, however, it pays to pay less than others or nothing at all. He will gain more at the other players' expense.

But if everyone pays very little or nothing, everyone gets very little or nothing from the common pool.



Governance of the Commons

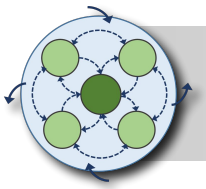
Can we also learn from small and large communities around the world about how to sustain shared natural and social resources (→ p. 2)? After all, people live in communities which depend on their resources, and many have done so for millennia. Some communities have existed for many generations and still today, others migrate or have to change their livelihoods, and others have perished. **How have different communities of people managed to survive for generations and to sustain their shared natural and social resources?**

Political scientist **Elinor Ostrom** and colleagues have been studying a **variety of common pool resources in the world** since the 1990s, such as fishing areas, grazing lands, irrigation systems, forests. She wanted to find out to what degree communities in the world are able to sustainably manage their community resources.

She found that communities can be quite capable of sustainable resource management, but not always. Certain factors and **conditions of the resource and social environment**, **norms and institutions**, and **behaviors of the user community** seem to have a strong impact on communities' ability to manage their resources sustainably.

Using real-life case studies on successful or less successful management of common pool resources in the world, we can explore the effects of these various factors and transfer our understandings to other issues of collaboration and sustainable resource use.

→ Q2. What are important conditions for humans to cooperate towards common goals?



Governance of the Commons

Ostrom's design principles for successful cooperation and successful management of community resources. The implementation of the principles may vary greatly depending on the context.

1 Clearly defined group boundaries and shared sense of purpose

It is clear who belongs to a to group, and all members have a shared sense of common goals. Everyone is "in the same boat" and everyone is aware of it.

2 Fair distribution of costs and benefits

The costs incurred by members for cooperation are distributed in proportion to their benefit from the cooperation.

3 Inclusive decision-making

Most individuals in the group can participate in decisions that affect them, set or change the rules of the game.

4 Monitoring

The community observes and monitors how a resource is used by all, how the resource condition develops, whether everyone behaves according to the rules, and to what degree common goals are achieved in relation to sustaining the resource.

5 Graduated responding to helpful and unhelpful behavior

Rewards for valued behaviors *and* sanctions for misbehaviors start at a low level (e.g. friendly discussion), and are increased in proportion to the contribution or detriment of the behavior towards the group

6 Fast and fair conflict resolution

There are local arenas and mechanisms for the fast, efficient and fair resolution of conflicts among members or with other groups.

7 Recognition of group and member autonomy

The group has a minimum of rights and the freedom to set its own rules, recognizing the autonomy of individuals or sub-groups within the larger unit in relation to different spheres of shared interests.

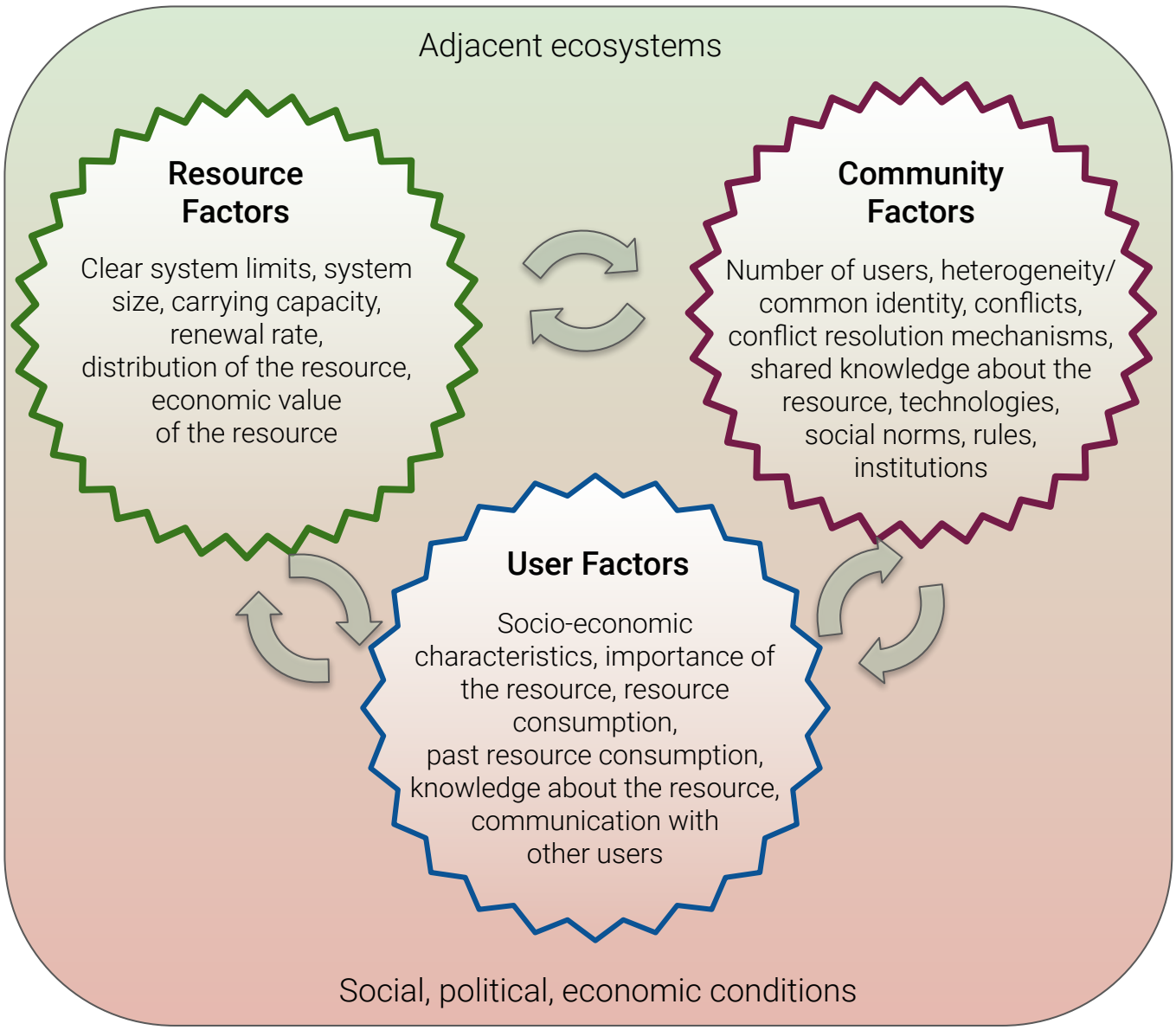
8 Appropriate relations with other groups

Groups are on many nested levels, with appropriate relations between levels of organization. Principles 1-7 apply to every scale of human social organization (polycentric governance).

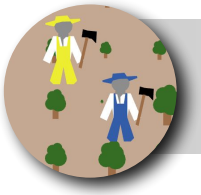
Source: adapted from Wilson, Ostrom, & Cox (2013); Atkins, Wilson, & Hayes (2019)

Governance of the Commons

Further environmental and socio-political conditions, as well as resource and user community factors, can influence how easy or difficult it is for a community to implement the principles of cooperation and sustainable resource management. We can explore how these factors interact through real-world case studies, as well as through computer simulations (→ p. 54 ff.) and experiments (→ p. 49) that model specific dynamics in common-pool resource situations.



Source: adapted from Ostrom (2009)

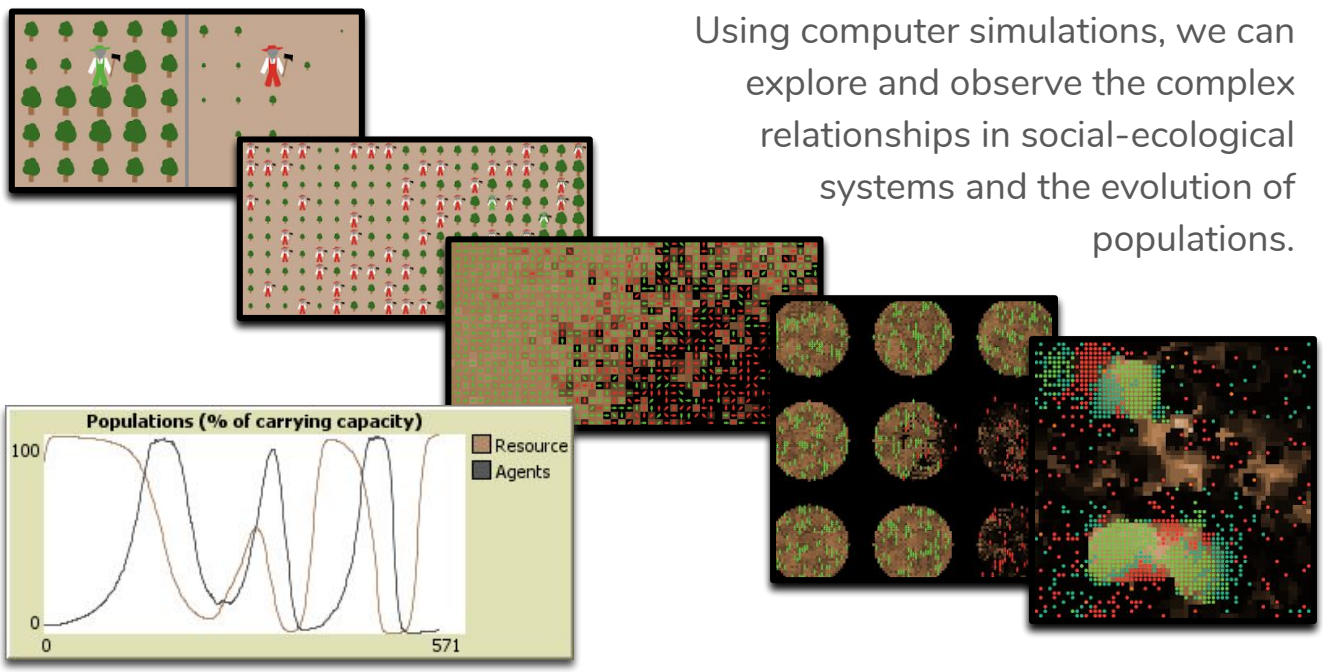


Computer Simulations

Evolution and **sustainability** are associated with multiple **learning difficulties** because evolution and sustainability are the result of complex interactions between organisms and their environment. These processes usually take place over larger dimensions of space and time and on several levels, and are therefore **far removed from our everyday experience**.

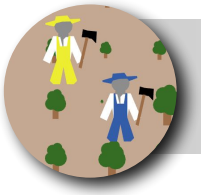
Computer simulations[1] can help overcome these learning difficulties - just like telescopes and microscopes, they allow us to recognize phenomena that are invisible to the naked eye[2]. Computer simulations can model processes over larger spatial and temporal dimensions, making them particularly suitable for observing, investigating and understanding evolutionary processes and interactions in social-ecological systems.

Evolution on the Computer



Using computer simulations, we can explore and observe the complex relationships in social-ecological systems and the evolution of populations.

[1] We develop computer simulations with the software NetLogo (Wilensky, 1999). [2] Goldstone & Wilensky (2008), p. 495

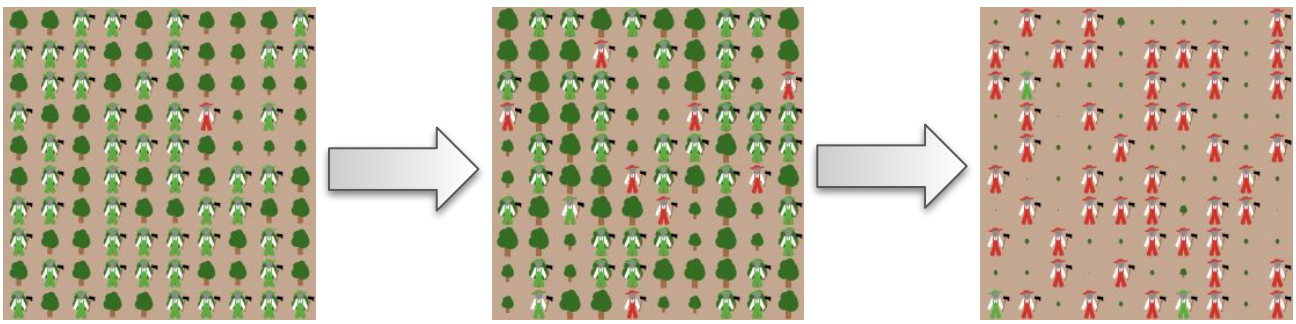


Computer Simulations

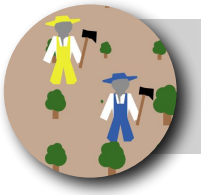
Competition for resources and evolution

Computer simulations can help us understand why maintaining shared resources can be challenging (→ p. 2). In computer simulations we can observe that competition among individuals sooner or later can endanger the maintenance of a common resource, and thus the entire population.

Because in the competition for resources, those that use more of the resource than others, or that can use the resource more efficiently than others, have a selective advantage. Their behaviors will spread in the population. However, when the entire population finally behaves like that - does this not lead to the depletion of the entire resource? And will this population not ultimately die out, or at least be plagued by a constant cycle of collapse?



Thus the **tragedy of the commons** (→ p. 2) is also an important concept in evolutionary biology. Evolutionary biologists examine the question of how different species and populations prevent the tragedy of the commons. Researchers are also investigating this question with the aid of computer simulations. How can we change the conditions and behaviors of elements in a computer model so that a population is not endangered by competition and resource overuse? And do we find similar conditions and behaviors in real-world populations?

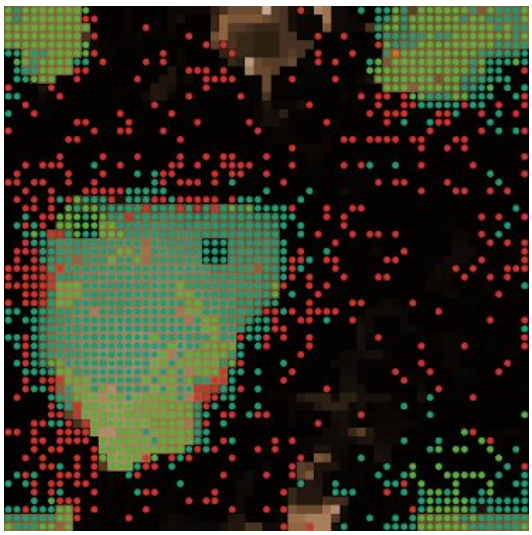


Computer Simulations

Cooperation and social behavior

Computer simulations can help us understand why social behavior or other mechanisms that limit competition and conflict within a population are central to the sustainable development of a community.

The degree to which everyone is in the same boat (→ p. 3, 4), is the degree to which cooperative social behavior will benefit everyone - even if it can lead to individual disadvantages in the short term. This view helps us explain why organisms such as bees (→ p. 20 ff.) have evolved sophisticated behaviors that allow them to persist as a community. This view helps us explain why we as humans also show behaviors that allow us to sustain cooperation in communities over long periods of time (→ p. 25, 41, 43). This view also helps us explain why communities in the world have developed certain norms and institutions that govern their coexistence within larger communities (→ p. 45, 52).



Computer simulations can help to understand the functions of these behaviors and mechanisms for cooperation and sustainable resource use in a community. By drawing connections between the models and other content anchors in the design concept, students can transfer this understanding to various sustainability dilemmas, past, present, and future.

→ U4. The evolution of human behavior is relevant to the sustainability dilemmas of today.

Our Mind

We can easily compare a human characteristic such as upright walking with that of other species - the similarities and differences are clearly visible in terms of behavioral and physical features.

However, our human **cognitive abilities** are more difficult to compare with those of other species. At the same time, these are questions that often fascinate us the most, especially when we observe our closest relatives and wonder - What are they thinking? Do they even “think”? What is "thinking"? What do they feel? What is important to them in life? Are they worried about the future, do they have hopes, are they making plans? Do they tell each other about their experiences, ideas, and feelings?

We can not see the behavior that happens in the brain from the outside - yet researchers also consider cognitive processes such as thinking and feeling as *behaviors*, that is, something that the body does, only that we can not see it from the outside.

We humans, through our language, can communicate and tell each other about our "inner behavior" - our thoughts and feelings. But how can we find out if other species have thoughts or ideas similar to our’s?

Our Mind

We can start simply by **observing and "exploring" our own minds**: what different things does it actually do? Scientists have come up with various **metaphors and analogies** to describe the different behaviors in our head and help us notice different processes of thought. For example:

- **"Fast Thinking", "Slow Thinking"** - some of our mental processes are more like automatically occurring intuitions, rapid unconscious information processing. Other mental processes happen more through conscious concentration and slow, deliberate reflection.
- **"Moral taste buds"** - We have moral intuitions that, similar to our taste buds, quickly make us judge between "sweet" or "disgusting", "good" or "bad", "just" or "unjust", "right" or "wrong", "us" or "them".
- **"Mental time travel"** - we can "travel through space and time" in our minds while our bodies and senses remain in the here-and-now.
- **The "noticer", the "discoverer" and the "advisor"** - with the help of the "noticer" we can perceive stimuli in our local environment and in our bodies in the here-and-now; with the help of the "discoverer" we try out new things and learn by trial-and-error; using the "advisor", our inner voice, we can try things out "in our heads" instead of in the world and learn from our experiences.

Why does our mind do these different things? Which of these different things do we have in common with other animals, and which not? With which do we come into the world, and which ones develop in the course of our lives?

Using different methods, scientists are studying the behavior of other species, of developing children and of people from different cultures, in order to understand the causes and functions of these different processes. These insights can also help us understand our own inner experiences, and perhaps deal with them more flexibly.

Our Mind

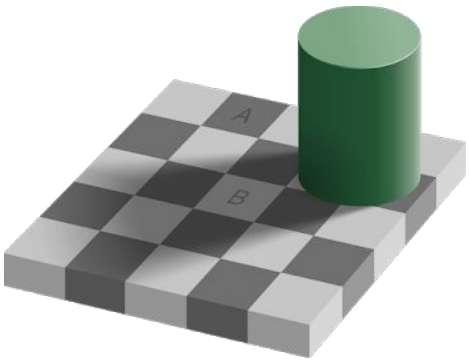
Thinking fast, and slow[1]

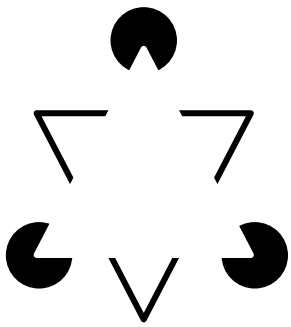
As we look more closely at our perception and thinking, we find that some of it is quite automatic and effortless. Other situations require our conscious concentration and can quickly make us tired. For example, calculating the solution for "2 + 2" feels to us quite differently than the solution for "17 * 23".

In psychology these different processes are sometimes roughly divided into two ways of thinking - a fast “System 1”, and a slow “System 2”. Often we think our System 2 is in control, when in fact System 1 dominates our perception, our thinking and acting. System 1 helps us to navigate and survive in a complex, dynamic world.

System 1	System 2
Fast	Slow
Automatic	Requires concentration
Unconscious	Conscious
Intuitive	Rational
Effortless	Effortful
Less flexible	More flexible

Optical illusions allow us to experience the work of our
"System 1" and to reflect on its functions.
Why does our brain distort and simplify our perception of the world?





[1] *sensu* Kahneman (2011)

Our Mind

Why thinking fast?

We have many of the mental activities of "System 1" in common with other species of animals, and we are born with some of these abilities. Other intuitions are developed in the course of our development through repeated experience of stimuli and practice. That's why we can barely suppress reading words in our mother tongue or solving "2 + 2", even though there was a time when this was new and hard work for us. The function of these unconscious and automatic intuitions, for us and other animals, is to quickly learn the regularities of our social and natural environment, to perceive them quickly and without much energy expenditure, and to respond to them rapidly. System 1 enables us to navigate and survive in a complex, dynamic world, but it does not always provide a factually accurate view. Simplified or distorted perceptions of the world have become part of how humans think because they may have no negative effects, and often positive effects for us. So we can not prevent that sometimes we see faces where there are none, or get “tricked” by other optical illusions. All we can do is learn when System 1 distorts and simplifies our perception of the world, and not always blindly trust our perception.

“The capabilities of System 1 include innate skills that we share with other animals. We are born prepared to perceive the world around us, recognize objects, orient attention, avoid losses, and fear spiders. Other mental activities become fast and automatic through prolonged practice.”

Daniel Kahneman (2011)

→ **U1.** Our everyday behaviors and experiences have many causes, some of which go all the way back to their evolutionary origins.

Our Mind

Why thinking slow?

The mental processes of System 1 and System 2 are not strictly separable - many processes are more or less automatic, more or less conscious, more or less flexible depending on many factors. Other species, e.g. primates, may have certain "slow thinking" skills. Nevertheless, the activities of System 2 seem to be particularly pronounced in us humans. They probably originated throughout our evolutionary history because certain mental abilities, such as controlling emotional impulses in social situations, focusing on activities such as learning and teaching the use and manufacture of complex tools, and coordinating body movements, have become increasingly important to the survival of our ancestors. System 2 is related to the activity of the cerebral cortex and we do not come into the world with it - it develops throughout our lives.

"The operations of System 2 are often associated with the subjective experience of agency, choice, and concentration. (...) When we think of ourselves, we identify with System 2, the conscious, reasoning self that has beliefs, makes choices, and decides what to think about and what to do."

Daniel Kahneman (2011)

We often think that our System 2 (our 'self', our 'intention', our 'will') is in control, after all we are mostly only *aware* of System 2. In fact, System 1 generally dominates our perception, our thinking and acting, in part because System 2 consumes a lot of energy and is exhausting! **Take a moment to reflect on how often and in what situations you and your mind use System 1 and System 2 thinking over the course of a day.**

→ **U1.** Our everyday behaviors and experiences have many causes, some of which go all the way back to their evolutionary origins.

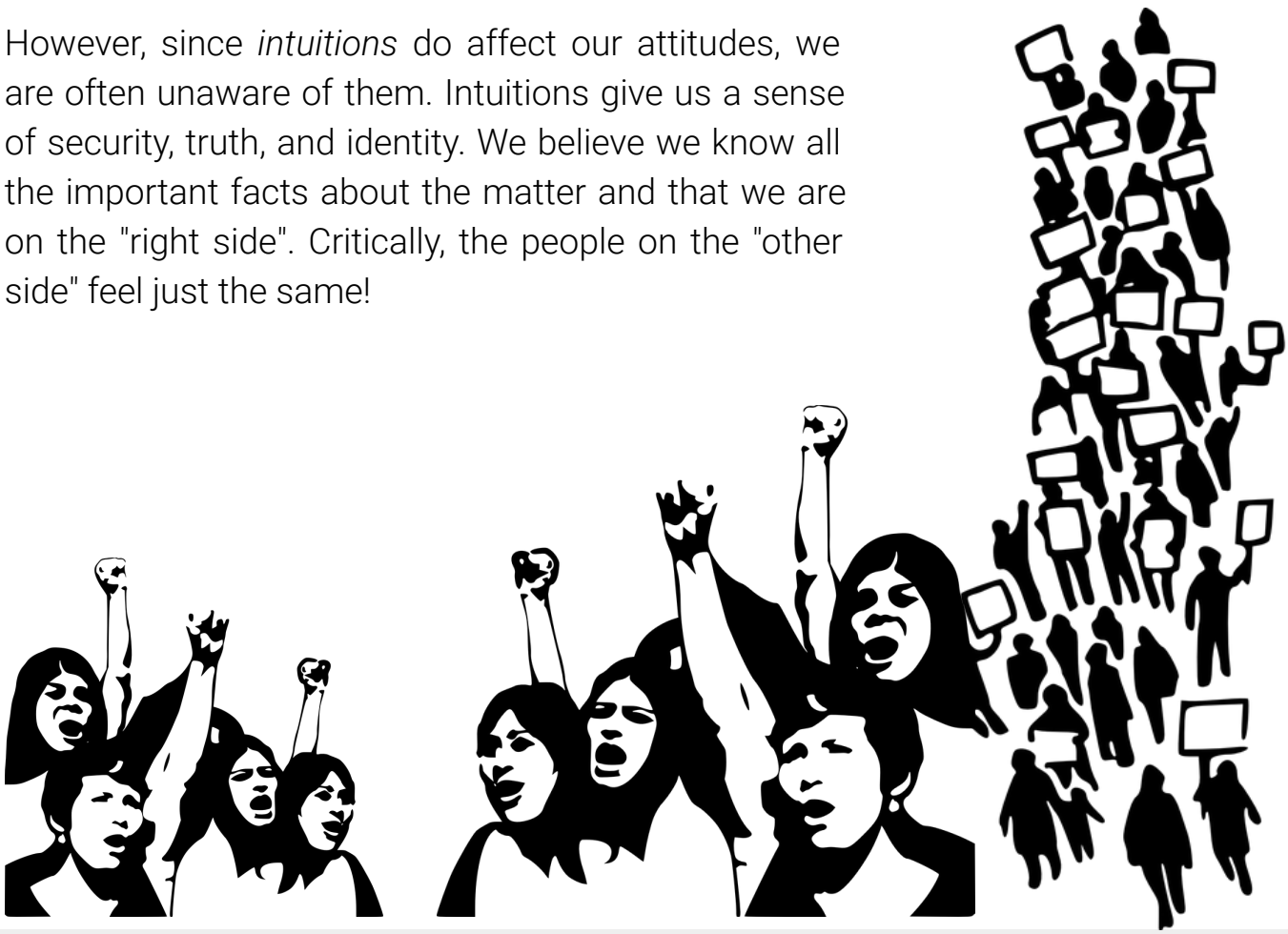
Our Mind

Fast thinking influences our opinions and judgements

A basic insight of social psychology is that our **beliefs about ethical-moral issues** are also largely **influenced by "fast thinking"**. People tend to quickly decide what is morally "right" and "wrong" through intuition and emotion, and only then, through conscious, rationalizing thinking, to find reasons that support their initial intuitions.

This fact alone does not mean that this is a bad thing! Because without this emotional component, people would hardly care to commit themselves to different purposes, to take to the streets, and to address perceived problems in society together with like-minded people.

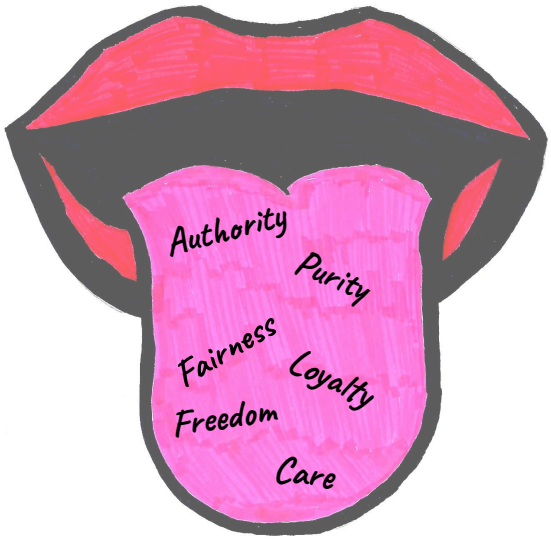
However, since *intuitions* do affect our attitudes, we are often unaware of them. Intuitions give us a sense of security, truth, and identity. We believe we know all the important facts about the matter and that we are on the "right side". Critically, the people on the "other side" feel just the same!



Our Mind

“Moral Taste Buds”?

Social psychologist Jonathan Haidt compares these moral intuitions with our taste buds. This analogy may help us to understand the evolutionary origins and the individual development of moral intuitions, as well as the variation in "moral tastes" among humans.



“We humans all have the same five taste receptors, but we don’t all like the same foods. (...) Just knowing that everyone has sweetness receptors can’t tell you why one person prefers Thai food to Mexican. (...) It’s the same for moral judgments. To understand why people are so divided by moral issues, we can start with an exploration of our common evolutionary heritage, but we’ll also have to examine the history of each culture and the childhood socialization of each individual within that culture.”

Jonathan Haidt (2012)

Just as all humans share the same taste buds because of our common evolutionary history, humans seem to also share a set of common moral intuitions because of our common evolutionary history. Our moral intuitions are part of our evolutionary heritage because they had a significant function in the group life of our ancestors. They helped them to notice conflicts in group living and to solve these together.

→ U2. Humans have been shaped by natural selection and cultural evolution to have an elaborated capacity to cooperate beyond kin.

Our Mind

Some of the "moral taste buds"[1] that have a big impact on our opinion. They can be of various strength among people, or be expressed in different situations, or in response to different stimuli.

Care / Harm

Protect others from harm, compassion, empathy,
aversion to violence, neglect

Fairness / Cheating

Others should have equal rights, duties, opportunities,
aversion to cheaters, free riders

Freedom / Oppression

aversion to oppression, restriction of freedom and liberty

Loyalty / infidelity

Fidelity to one's own group, patriotism, sacrifice for one's own group, aversion to treachery, infidelity

Authority / Subversion

Respect for traditions, established institutions, legitimate authorities, leadership, order, stability,
aversion to instability, change, disobedience

Purity & Sacredness / Disgust & Degradation

Attachment to what is considered "pure" and "sacred",
aversion to violations of social norms and contamination

[1] adapted from Grinberg et al. (2018), Haidt (2012)

Our Mind

Morality binds and blinds

Just as cultures of the world have developed their own regional cuisine, each community builds its own "moral cuisine" out of the moral taste buds, shaped by (or even as an adaptation to) historical and socio-ecological circumstances.

Just as individuals have developed their own eating habits and food preferences, people also have different "moral tastes" due to their different experiences and influences from their socio-cultural environment.

Just as humans can develop a shared identity around common cultural cuisine, our intuitions about "right" and "wrong", "good" and "bad", "normal" and "unnormal" allow us to develop an identity with other people and work together for common goals (→ p. 41, 43).

At the same time, however, these intuitions make us distinguish "our" group from others, with the consequence that we do not open ourselves to the important insights and information of others, and have difficulty working together toward common goals, even when we may actually be in the same boat.

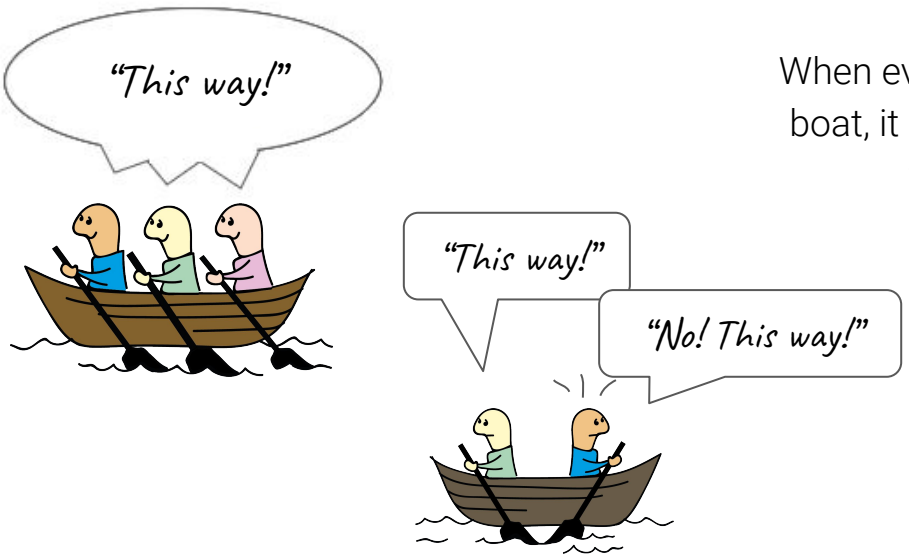
"Morality binds and blinds. It binds us into ideological teams that fight each other as though the fate of the world depended on our side winning each battle. It blinds us to the fact that each team is composed of good people who have something important to say."

Jonathan Haidt (2012)

Our Mind

Thus, social problems (including sustainability challenges) often lead to disagreements between people about what is "important" and "right." Often people are divided into groups, and each group considers itself and its attitudes to be "good," "normal," and "justified." The others appear "abnormal", "bad", "dangerous", "ignorant" and "morally reprehensible".

Because of our moral taste buds and our propensity to divide our social world into groups, humans often have a hard time coming to the same beliefs and conclusions through exchange of experiences and opinions, unlike the efficiency of decision making in a bee colony (→ p. 20 ff.)? However, such an open exchange of opinions with everyone in our group is the foundation of a functioning democracy and helps us to learn.



When everyone is in the same boat, it is important to decide the direction together.

Awareness of and reflection on the many causes of our opinions and the opinions of others, especially on the role of individual experiences, moral intuitions, and our deeply rooted tendencies for groupish thinking, can promote mutual understanding, openness to new views, and a more constructive exchange of ideas.

Our Mind

“Mental time travel”[1]

As we look more closely at our perception and thinking, we also find that we are quite often "somewhere else". We may be physically sitting in the room, walking down the street, or lying in bed, but in our minds we are wandering around in time and space: we remember a situation of yesterday or last year and replay it like a movie, we imagine ourselves in a situation tomorrow or in 10 years, and wonder or worry about all sorts of situations that have nothing to do with our perception in the here-and-now.

Scientists call this mental behavior "**mental time travel**". Why do we have this behavior? Can other species do that too? Why or why not? None of us can remember our first birthday. But if you are old enough to read this text, then mental time travel probably determines much of your everyday experience, sometimes in a negative way, and sometimes in a positive way. How and when do we develop this behavior in the course of our lives?

Mental time travel

- Function: To use past experience to imagine different possible futures and act in the present to move towards selected future goals
- Mental time travel depends on parts of the brain evolved among many animals. Some animals possibly have the ability to imagine immediate past and future. However, in us humans this ability has been vastly elaborated.
- It develops in the course of our life. Children increasingly gain an idea of the past and the future, and integrate these ideas into their actions. Through language and the transmission of cultural knowledge we gain an idea of an ever more distant past and future.
- Mental time travel can occur automatically (System 1), but can also be consciously controlled by us (System 2).

[1] *sensu* Suddendorf & Corballis (1997)

Our Mind

"What is in your pockets? Chances are you carry keys, money, cosmetics, a Swiss Army knife, or other tools—because they may be useful at some future point. Humans have the ubiquitous capacity to imagine, plan for, and shape the future (even if we do frequently get it wrong). This capacity must have long been of major importance to our survival (....) and may have been a prime mover in human cognitive evolution. Stone toolkits and spears from archaeological finds suggest that the ancestors of modern humans already prepared for the future hundreds of thousands of years ago. (...)

Of course, other animals also act in ways that increase their chances of future survival. Many species have evolved preparatory instincts that lead them, for example, to build nests or hoard food. [Learning] further allows individuals, rather than entire species, to predict recurrences on the basis of cues (for example, a smell signaling food). (...)

Great apes even seem capable of imagining situations they cannot directly perceive. They can also make simple tools to solve nearby problems, such as fashioning an appropriate stick to obtain food that would otherwise be out of reach. Yet there seems little evidence that animals ponder the more distant future."

Thomas Suddendorf (2006)

"A good deal of human conversation consists of mutual time travels down memory lane. Shared memories are the glue for the enlarged and complex social nets that characterize our species and that go well beyond mere kinship."

Suddendorf & Corballis (1997)

→ **U2.** Humans have been shaped by natural selection and cultural evolution to have an elaborated capacity to cooperate beyond kin.

Our Mind

The “Discoverer”, the “Noticer”, and the “Advisor”

Other behavioral researchers[1] have developed the metaphors of the "noticer," "discoverer," and "advisor" to distinguish different behaviors in our mind.

The Noticer

- Function: To detect physical, psychological, and environmental stimuli in the immediate here-and-now
- The noticer is evolutionarily very old, depending on how one defines "sensing" and "perception".
- We are born with the noticer.
- The noticer is automatic (System 1), but can also be consciously controlled by us (System 2). It does not travel in space and time.

The Discoverer

- Function: To increase our possibility for new behaviors and understandings through trial-and error learning
- The discoverer originated about 500 million years ago and we have it in common with many animals. Apes seem to have particularly active discoverers within their minds.
- We are born with the discoverer.
- The discoverer can make use of the noticer and advisor, and can travel in space and time.

The Advisor

- Function: To use prior learning, experience and language in order to learn from experience, simulate possibilities, and reduce the need for trial-and-error learning
- The advisor may be an evolved trait unique to humans.
- The advisor develops across our lives through relationships with other people and language learning.
- The advisor is influenced by fast thinking (System 1), but it can also be controlled by us (System 2). It often travels around in space and time.

[1] Hayes & Ciarrochi (2015), Ciarrochi & Hayes (2018)

Our Mind

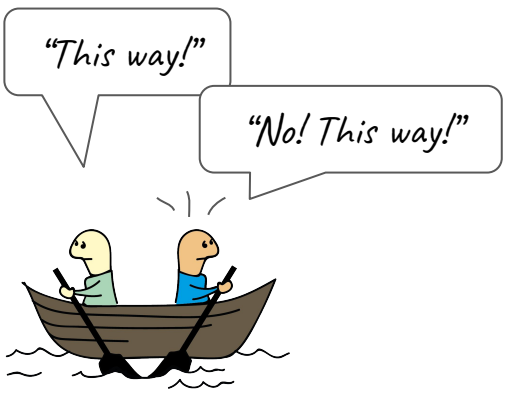
The characters in our mind are not always helpful

While all of these behaviors or characters in our mind have important functions and help us act in ways that are important for our survival and well-being, sometimes they are not very useful. For example:

- Fast thinking can give us distorted information that is not helpful to us or leads to social conflict.
- Mental time travel can make us experience negative experiences from the past over and over again, and can make us worry too much about the (imagined) future. It can affect our well-being and behavior in the here-and-now in ways that are not helpful.
- The advisor (the inner voice) can give us too much useless advice or too many negative evaluations (about ourselves, our live, other people, our circumstances). It can affect our well-being and behavior in the here-and-now in ways that are not helpful.

"Although we humans have gained the ability to extract ourselves from the physical jungle, through language we are now recreating the danger of the jungle in our heads again and again."

Hayes & Ciarrocchi (2018), p. 118



Also, the characters sometimes struggle for our attention and want to influence our behavior in different directions. However, they all sit in the same boat (our body), and it would be better for our well-being if they decided the direction together.

Our Mind

Noticing the characters in our mind and using them for positive purposes

Most of the time the characters are automatic (System 1) and we can not simply "turn them off" or “get rid of them”, because they are part of our evolutionary heritage. So what can we do if one of the characters “wants” to dominate our perception and action, and is not being particularly useful?

We can learn to **use our noticer to observe the workings of the characters in our minds from a distance**. This way we notice how the characters, as well as our external environment, affect our present state, and how they want to direct our actions, but we do not necessarily have to follow their orders. Some psychologists call this ability *mindfulness*.

> *“No matter how confusing, difficult, or busy life gets, we can always shift into noticer behavior and find our center and stability.”*
>
> Hayes & Ciarrochi (2015), p. 17

In addition, we can learn to **let our behavior be directed by what is really important and worth living for us**, rather than by what the characters are currently proposing to us. We can learn to take the characters in our minds seriously when they are useful for achieving our goals, and to take them less seriously when they have nothing useful to offer.

Some psychologists call this ability "psychological flexibility"[1]. It is the ability to use the behaviors of our mind, which are the result of evolution and our development, more flexibly, in the service of achieving our goals and living in line with the things we care about.

[1]e.g. Kashdan & Rottenberg (2010)

Our Mind

"What can be done about biases? How can we improve judgments and decisions, both our own and those of the institutions that we serve and that serve us? The short answer is that little can be achieved without a considerable investment of effort. As I know from experience, System 1 is not readily educable. (...) [M]y intuitive thinking is just as prone to overconfidence, extreme predictions, and the planning fallacy as it was before I made a study of these issues. I have improved only in my ability to recognize situations in which errors are likely."

Daniel Kahneman (2010)

"Sometimes it is beneficial to be immersed in the present to appreciate the array of beauty walking through the neighborhood, the wisdom of what a person offers in conversation, or striving to finish a memo before the workday is over; sometimes it is beneficial to be positioned in the future, clarifying values, future goals to link with those values, and specific, planned behaviors to make progress toward those goals; sometimes it is beneficial to be in the past, whether it is savoring experiences for a mood boost, re-connecting with one's personal history, extracting life lessons, or working to synthesize and create coherence from a variety of interesting experiences. (...) If these examples suggest anything, it is that greater satisfaction and meaning in life can be captured by shifting temporal perspectives when the situation requires a particular mode of being."

Kashdan & Rottenberg (2010)

Global Sustainability Goals

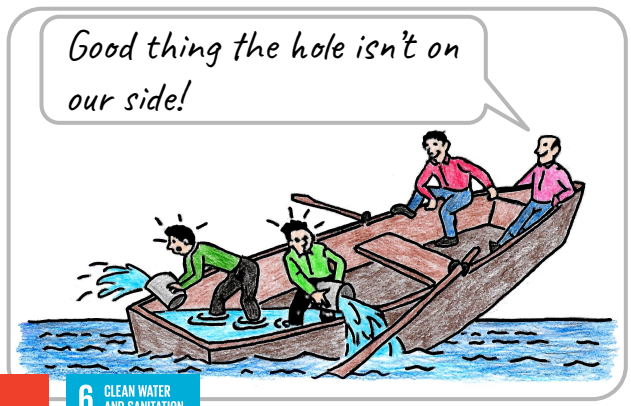
“All in the same boat”?

Because of the **interrelationships in a globalized world** and the impact of our behaviors on **global ecosystems** today, global society ultimately sits in one boat. We are part of a **global public goods game** (→ p. 49) in which the rules are not (yet) clearly defined, and in which mistrust and uncertainty prevail.

In this situation, it is a challenge to align the interests of individuals (including individual groups) with the interests of the global community. The potential for selfish behavior, competition and conflict is high.

Social inequality, the rigidity of international negotiations, political and economic abuse of power, nationalist movements, serious disagreements on complex societal issues are the consequences that we can observe today, which hinder the achievement of global sustainability goals.

To what extent can our evolved human characteristics be obstacles and opportunities to coping with these challenges?



Global Sustainability Goals

Mismatch?

When adaptations to previous environmental conditions are no longer adaptive under the given environmental conditions, biologists describe this as an instance of **evolutionary mismatch**. Are problems of sustainable development at different levels of society an indication of such a mismatch between our evolved traits and the modern environment?

After all, **cultural evolution** (→ p. 37, 45) has fundamentally changed the social and natural environment of humans within a few generations and a few decades. Do we have a "stone-age brain" that can not cope with these changes?

On the other hand, a **special flexibility characterizes our species**: We humans, especially our perception, our behaviors, our norms and cultures are less influenced by genetic inheritance alone, and significantly influenced by the social environment and experiences in the course of our development (→ p. 30, 32). What was normal for the previous generation may be unthinkable and unacceptable to the next generation, and vice versa. **Our cultural evolution goes hand in hand with the flexibility of our species.**

The content anchors help us to understand the causes of human perceptions and behaviors. They are the result of the biological and cultural evolution of our species, of our individual development as well as of immediate internal factors and external environmental conditions. To what extent **can we use our understanding of these causes of our human characteristics** to prepare for the challenges of sustainable development and to avoid the effects of potential mismatches?

→ Q5. What is the relationship between human evolution, behavior, and sustainability?

Global Sustainability Goals

Global Identity?

The many topics from the content anchors show us that humans have the ability and the motivation to tackle the multifaceted challenges of collaboration in ever larger groups, by identifying shared interests, common values and goals, learning from each other and teaching each other, communicating, finding common solutions, developing common norms and institutions, and committing to safeguarding their social and natural environment. In fact, these abilities and motivations seem to distinguish us as a species.

> *"A perspective that looks at the challenges of international cooperation from the starting principle that people can and do cooperate could improve the chances of global cooperation."*
>
> Messner, Guarín, & Haun (2013)

These are human traits that we can build on. However, the challenge is to translate these insights to the problem of *global* cooperation, while recognizing the need for working together in appropriate degrees at scales below this. Never before in the history of our species have we needed to deal with cooperation on this global level, or to think more clearly regarding on which levels different communities are in the same boat.

> *"We suggest that some of the key difficulties of global governance stem from a period of transition in which reciprocity, trust, communication, reputation, enforcement, we-identity and fairness need to be re-negotiated, re-established, or even reinvented."*
>
> Messner, Guarín, & Haun (2013)

Global Sustainability Goals

Our ability to create a common identity with many people has been, in the history of our species, associated with a demarcation of "the others" (→ p. 43, 65). This factor continues to shape discussions and disagreements around the "right" priorities and solutions for the sustainable development of our species. How can we create a global identity that is not endangered by such groupish thinking?

"Since states first appeared c. 5000 years ago, their maximum size has been gradually increasing. (...) But does it mean that the trend to ever larger states will continue and a global state is inevitable? Up until the present the force driving the evolution of increased social scale has always been competition/conflict in opposition to some other societies. If the global state were to arise, where will it find the external threat that would keep it unified? (...) On the other hand, neither history nor evolution is destiny. Humans have transcended their evolutionary limitations before. (...) We just should not expect this to happen automatically, simply as a result of a 5,000-year trend of increasing state size."

Turchin et al. (2009)

"(T)he best way to motivate people to collaborate and to think like a group is to identify an enemy and charge that "they" threaten "us." (....) Such group-mindedness in cooperation is, perhaps ironically, a major cause of strife and suffering in the world today. The solution—more easily described than attained—is to find new ways to define the group."

Michael Tomasello (2009)

Global Sustainability Goals

Cultivating awareness about human behavior

The concepts explored across the content anchors show us that some of the human characteristics emerging through biological and cultural evolution may present particular obstacles to human well-being, international cooperation, as well as the sustainable development of our species:

- Many of our behaviors are influenced by (moral) intuitions and (social) emotions that occur automatically in a way that we are often unaware of, and this can sometimes have positive or sometimes negative effects for ourselves and others (→ p. 59 ff.).
- Symbols, language and mental time travel shape our perception and influence our behavior, and this can sometimes have positive or sometimes negative effects for ourselves and others (→ p. 43, 67 ff.).
- We intuitively divide our social environment into groups, leading us to collaborate within "our" group, but at the same time to differentiate ourselves from other humans, and this can sometimes have positive or sometimes negative effects for ourselves and others (→ p. 30, 43, 65, 66).

Psychologists, anthropologists, and behavioral scientists have recognized that these human behaviors under today's environmental conditions are significantly linked to problems such as unhealthy eating habits, physical inactivity, stress and depression, social isolation, (cyber-) bullying, materialism, nationalism and xenophobia, social conflicts over ethical and moral affairs, and social inequality.

→ U4. The evolution of human behavior is relevant to the sustainability dilemmas of today.

Global Sustainability Goals

However, the content anchors also help us understand how certain conditions and causal relationships can promote or hinder the development of all these human qualities, abilities, motivations, and behaviors.

Many behavioral scientists are concerned with using this knowledge in a way that allows us to change our behaviors and (social, natural) environmental conditions, so that they may promote human well-being and the sustainable development of our species:

- **Which conditions promote or endanger human well-being, learning and cooperation? Can (and should) we shape environmental conditions** in a way that they promote people's abilities and motivations to learn from each other, to work together and to act on a daily basis in accordance with goals of human well-being and sustainability?
- **Which behaviors promote or endanger human well-being, learning and cooperation? Can (and should) we help humans to develop these behaviors?** Can we support humans in becoming more aware of their intuitions, emotions, behaviors, and differing levels of shared values, and to understand their causes and consequences? Might this understanding support them in persisting in the face of challenging conditions?
- **What role can (and should) our technologies, policies and regulations, social norms, media, and education play in creating these environmental conditions and in promoting these skills?** Would a more broadly shared understanding of our own species change how we discuss these aspects of society?

Global Sustainability Goals

"Imagine if we could teach young people to become mindful of the ways that symbols can dominate our interpretations of experience and can become unhelpful. They might then learn to use symbols like tools, and "put them own" when no longer useful. They might become less caught up in self-criticism, materialism and prejudice. Could they pass these lessons on to their children? Or imagine if all young people learned to judge their behavior in terms of how it served their values, and especially how it helped them build connection and love? Or imagine young people who understood that they are not fixed, and the future is not fixed, and they can improve themselves and this world. What might they teach their children?"

Hayes & Ciarrochi (2018), p. 121

"We would argue that there is a major difference between behavioral science (...) and every other area of scientific progress. (...) Most people who make daily use of the technologies that have so changed the world in the past century, need not understand the science that led to and underpins the efficacy of their computers, cell phones, televisions, automobiles, air conditioners, and so on. (...)

The situation is a little different when it comes to the behavioral sciences (...). [T]ranslating the advances in scientific understanding of human development into comparable improvements in human well-being requires that we get most people in society to understand – at least in rough outline – what humans need to thrive."

Biglan et al. (2015), p. 537, 538

Global Sustainability Goals

Understanding global causal relationships

Evolution does not stop: Causal relationships between our behavior, our well-being, our social and natural environment, and our cultural institutions and technologies have shaped us as a species, shape our present, and continue to shape our future.

These relationships are complex, and are extending over larger dimensions of space and time. So, the effects of our actions are not always what we expect them or would like them to be. However, the Global Sustainable Development Goals require that we **understand these causal relationships**, so that we can **influence them in a direction that we all want**.

The positive thing is that today, thanks to diverse scientific disciplines, we know a lot about these causal relationships. We can understand the impact our behaviors and technologies have on our well-being and our environment. We can ask important questions to shape our preferred futures. What progress is there? Where are the biggest challenges, the biggest opportunities, the biggest strengths and weaknesses? In which of these factors is there an opportunity or a necessity for us, as individuals and as communities, to intervene?

"Every one of us has an idea of how the world is changing. Is the world becoming more violent? Is an end to poverty possible? Is population growth unstoppable? Will environmental decline inevitably make the planet uninhabitable? To answer these and other big picture questions, it is essential that we carefully measure what we care about, and let the facts inform our worldview."

"Understanding how and why the world has changed up to now allows us to see that a better future is possible."

Our World in Data (2019)

Tinbergen's Questions

.... to explore the different causes of behavior

Behavioral biologists (or ethologists) explore the causes of behavior in humans and animals. On the one hand, we have to look for causes of behavior in the past - what happened before the event and contributed to the expression of a behavior? Some causes are due to immediate factors, others to more recent factors such as events in individual development and others are in the history of a population. On the other hand, we need to look at the function of a behavior - what function and what consequences does the behavior have for the behavior itself, for the individual and his environment?

The behavioral biologist **Nikolaas Tinbergen** (1907-1988) was particularly influential for dividing these different causes into four different types:

- Immediate triggers and proximate physiological mechanisms
- Causes in the development of individuals
- Causes in ancestral (cultural and evolutionary) history
- Causes that are related to the function or adaptive value of the behavior and that cause an individual to repeat the behavior (or not), or that lead to the behavior becoming more or less common in a population.

However, it was also clear to Tinbergen that different causes of behavior can not always be strictly separated, and that they all contribute to the explanation of an observed behavior. He offers an example from his post-war era perspective in the quote below:

> *"[O]ne can say that a man is afraid of a flying plane "because he sees it" but also "because he has been bombed out as a child". The main point is to recognise that both statements may be true, that each covers part of the total causal chain involved, and that the question "what made him behave the way he did?" requires a complete answer in which both partial answers are contained."*
>
> Tinbergen (1963), p. 427

Tinbergen's Questions

.... to explore the different causes of behavior

So behavioral biologists and ecologists are aware that behaviors have many causes. If we want to understand our own behavior and the behaviors of others, we should discuss these different causes.

"There are few clear-cut causal agents - so don't count on there being ***the*** *brain region,* ***the*** *neurotransmitter,* ***the*** *gene,* ***the*** *cultural influence, or* ***the*** *single anything that explains a behavior."*

Robert Sapolsky (2018), p. 386

"A behavior has just occurred. Why did it happen? Your first category of explanation is going to be a neurological one. What went on in that person's brain a second before the behavior happened? Now pull out to a slightly larger field of vision, your next category of explanation, a little earlier in time. What sight, sound, or smell in the previous seconds to minutes triggered the nervous system to produce that behavior? On to the next explanatory category. What hormones acted hours to days earlier to change how responsive that individual was to the sensory stimuli that trigger the nervous system to produce the behavior? And by now you've increased your field of vision to be thinking about neurobiology and the sensory world of our environment and short-term endocrinology in trying to explain what happened.

And you just keep expanding. What features of the environment in the prior weeks to years changed the structure and function of that person's brain and thus changed how it responded to those hormones and environmental stimuli? Then you go further back to the childhood of the individual, their fetal environment, then their genetic makeup. And then you increase the view to encompass factors larger than that one individual - how has culture shaped the behavior of people living in that individual's group? - what ecological factors helped shape that culture - expanding and expanding until considering events umpteen millenia ago and the evolution of that behavior."

Robert Sapolsky (2018), p. 6, 7

Tinbergen's Questions

.... to explore the different causes of behavior

The following overview can support the implicit or explicit classification of different causes of a behavior in the classroom. We can engage content from across the content anchors to explore specific types of causes.

An observable trait/ behavior/ phenomenon in biology or society		How was it triggered? How and when did it come about?	What outcomes does it create? Why does it exist today? (Adaptive function)
Near Past ↑	**Mechanism(s)** Milliseconds, seconds, minutes, hours, days before	**Internal**: sensory perception of environmental stimuli, emotions, thoughts, System 1, System 2, hormones, gene expression **External**: stimuli in the social, cultural, biotic, abiotic environment	How does the observed trait function in its context regarding its survival/ retention/ reinforcement/ transmission/ reproduction?
	Development Months, years, decades ago	**Internal**: experiences, memories, habits, parental effects, epigenetics, genes **External**: social, cultural, biotic, abiotic environment	How has the trait, its mechanism and its development functioned over life history regarding its survival/retention/ reinforcement/ transmission/ reproduction?
	Cultural history decades, centuries, millenia ago		
Distant Past	**Evolultionary history** Thousands, millions of years ago	**Internal**: genes, epigenetics, developmental processes, homological structures and functions **External**: social, cultural, biotic, abiotic environment	How has the trait, its mechanism and its development functioned over (cultural and) evolutionary history regarding its survival/retention/ reinforcement/ transmission/ reproduction?

Causal Mapping

.... to illustrate complex causal relationships

Causal maps or diagrams are used in research and education to investigate and illustrate cause-and-effect relationships in various phenomena.

In causal maps, features, conditions or other variables and factors are linked by arrows that indicate a kind of causal relationship - X leads to, changes or influences Y.

These cause-and-effect relationships can be of different types. The concrete nature of a causal link can be stated if it is known or assumed, or it can remain general when the aim is to explore, discuss, or reflect on it.

For example, "is consumed by" is a causal relationship in a food web of an ecosystem. **"selection pressure for"** is a kind of causal relationship (natural selection) in which a condition "leads to an increase in the frequency of the trait in the population." Depending on the trait, different selection and inheritance mechanisms can be at work, e.g. biological reproduction or imitation (→ p. 37).

When three or more factors are linked by causal relationships, it becomes more and more difficult to predict the consequences of these interactions - one speaks of **complex causal interactions**.

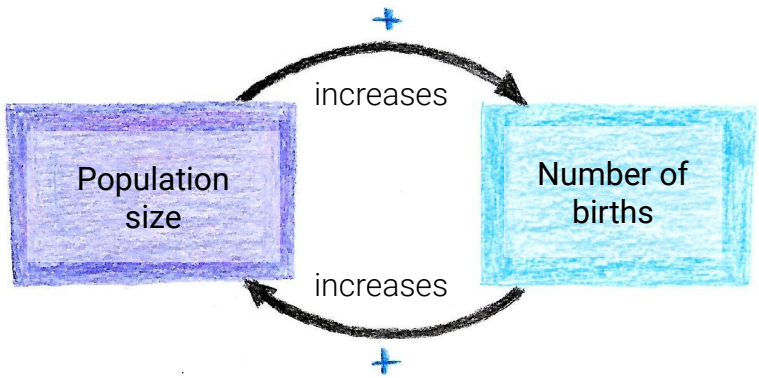
Complex systems are characterized by such complex causal relationships. We find them in many areas, e.g. **in biology, psychology, ecology and society**.

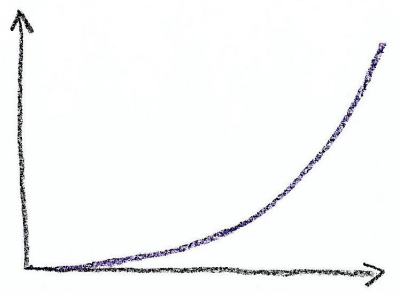
Causal Mapping

.... to illustrate complex causal relationships

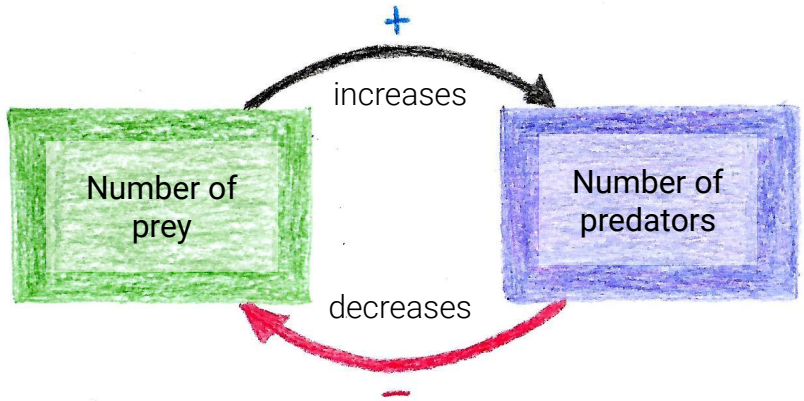
Among the interactions in complex systems one often finds **“feedback loops”**. In feedback loops, there is not only a link from cause to effect, but also a relationship of effect back to the cause. Feedback loops play a key role in the change (or stability) of complex systems.

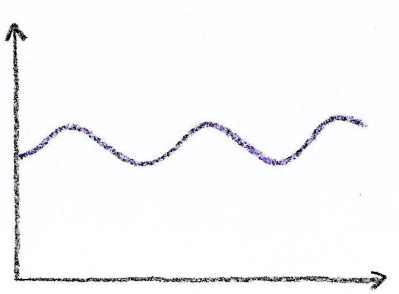
Positive feedback loops are processes that reinforce themselves - the more of something there is, the more of it is generated, or the less of something there is, the less of it is produced. An example is exponential growth of a population.





Negative feedback loops are processes that dampen themselves - the more of something there is, the less of it is produced, or vice versa. An example is the interaction between predator and prey populations. Negative feedback can cause systems, e.g. living organisms and ecosystems, to regulate themselves (without a central leader). Many regulatory processes of our body are therefore examples of negative feedback.



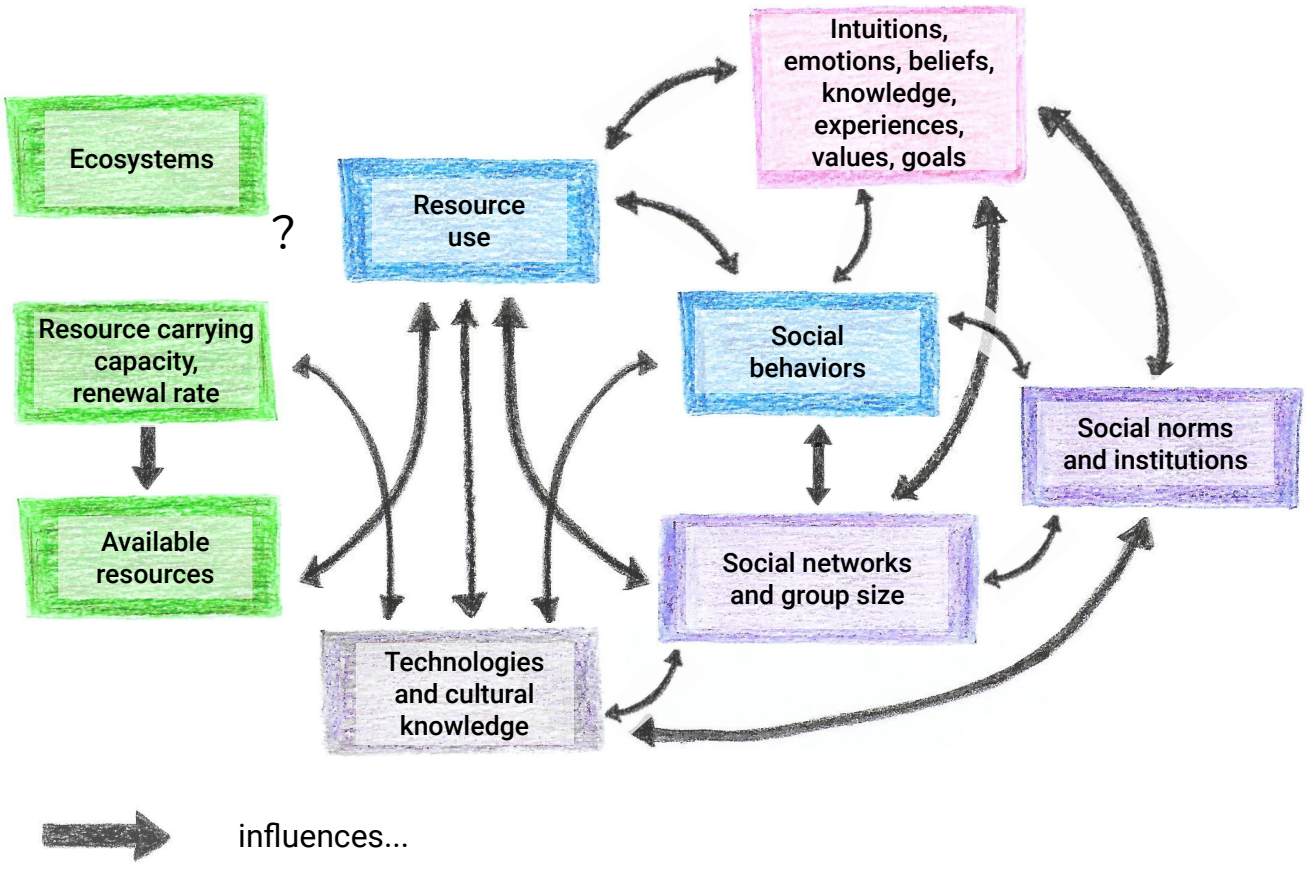


So the words "positive" and "negative" have nothing to do with whether a process is "good" or "bad", but merely describes the dynamics - positive means "more leads to more" or "less leads to less" , negative means "more leads to less" or "less leads to more".

Causal Mapping

.... to illustrate complex causal relationships

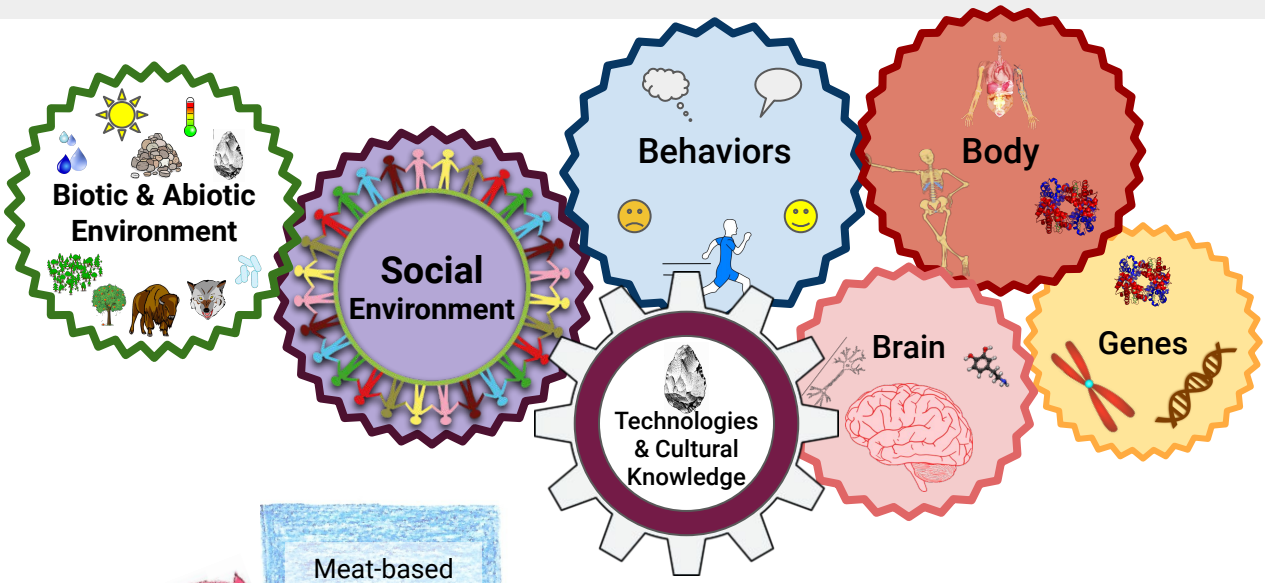
Particularly the development of our global social-ecological system is characterized by feedback loops that arise from the interplay between environmental conditions, our technologies and institutions, the behavior of individuals, and the social interactions between individuals. Hence many drastic changes today - such as population growth, resource consumption, climate change and technological innovation - are the result of positive feedback loops. Some of them are moving in a direction we deem to be "good" - they are helpful for achieving our common goals. Others are moving in a direction we deem "bad" - they present challenges in achieving our common goals.

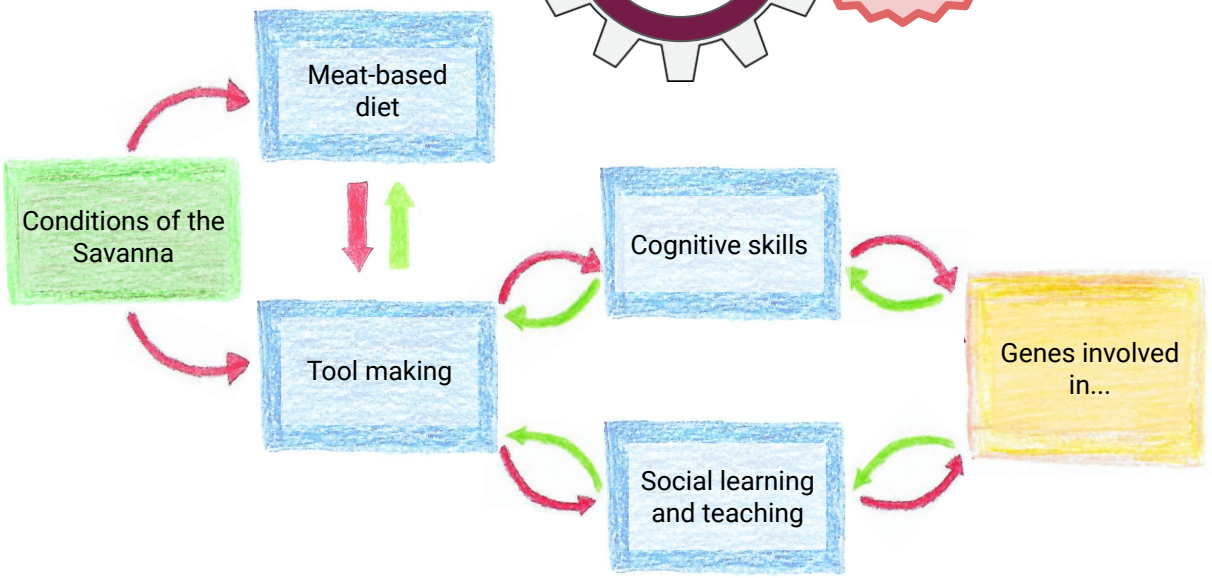


How do our social and natural environment, our behaviors, our perceptions influence each other? Causal maps allow teachers and students to reflect on concrete relationships between these factors in specific contexts and to discuss ways in which we can consciously influence the evolution of these interacting factors, both individually, and as a community.

Causal Mapping

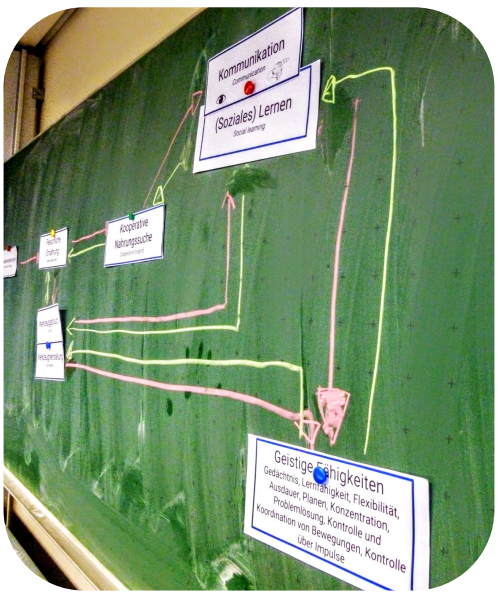
.... to illustrate causal relationships in the evolution and development of traits





Requires, favors the natural selection of...

Enables, facilitates, favors the development of...

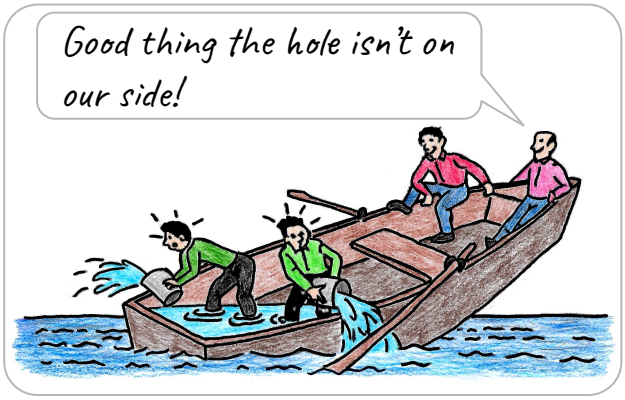


Payoff Matrices

…. to explore the motivations and outcomes of human behaviors in particular situations.

Many situations in our everyday experience are **social interactions** - outcomes for us are not just influenced by how *we* behave individually, but also by how *others* around us behave. This is because we humans live in social groups and in a world that is changed and created by other humans. When we are all in the same boat, the way others on our boat behave can have outcomes for us.

Evolutionary biologists, economists and sustainability scientists sometimes represent the costs and benefits that people (or other animals) get from a behavior through a so-called **payoff matrix**. Using payoff matrices in the classroom helps us reflect on the possible causes and consequences of behaviors in particular situations.



What motivates the red guys in this boat to not help the green guys? What motivates the green guys to work so hard?
What might be the outcome of each of the guy's behavior for everyone in the boat?
Can outcomes of a behavior be different in the short-term and in the long-term?

Person A	Person B/ all the other people on my boat: If I work hard to scoop as much water as I can, then….	Person B/ all the other people on my boat: If I sit back and don't do any work, then….
If I work hard to scoop as much water as I can, then….	Our boat won't sink and none of us will drown. / Our boat won't sink and none of us will drown.	I don't have to spend any energy, I don't see the problem, or may the other guys will stop the boat from sinking, maybe not. / Maybe I can stop the boat from sinking. But maybe not, because the others aren't helping.
If I sit back and don't do any work, then….	Maybe I can stop the boat from sinking. But maybe not, because the other guy isn't helping. / I don't have to spend any energy, I don't see the problem, or maybe the other guys will stop the boat from sinking, maybe not.	Our boat will sink and maybe all of us will drown. / Our boat will sink and maybe all of us will drown.

Payoff Matrices

.... to explore the motivations and outcomes of human behaviors in particular situations.

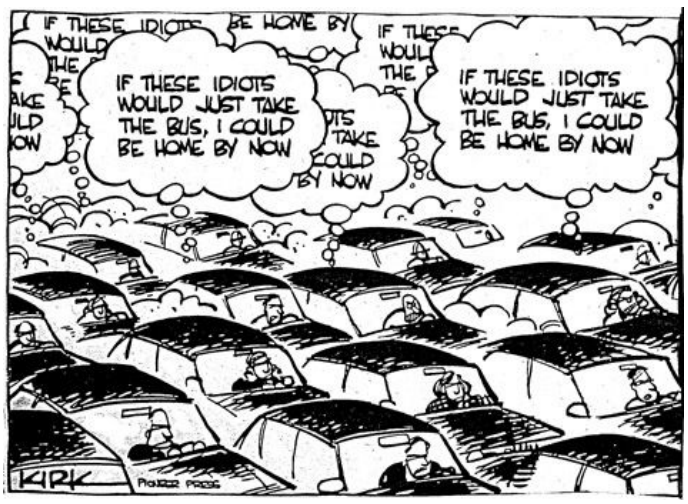
Payoff matrices help to **identify whether there is a social interaction between individuals**. This helps us understand the level or size of group we need to look at in order to understand the causes and outcomes of behaviors in a social-ecological system.

Payoff matrices also help to **identify whether there is a social dilemma** between what individuals are motivated to do in the short-term and what is best for the community in the long-term (→ p. 2-4).

Social dilemmas seem to be at the heart of sustainability challenges. Sustainability scientist explore how we can solve such dilemmas by finding ways to align the interests of individuals with the interests of the whole group.

Some essential questions that the payoff matrix helps explore:

- What motivates humans to behave in a certain way in a certain situation? What is the role of intuitions and emotions, beliefs, personal preferences and goals, and learned social norms?
- What outcomes does a behavior create in a certain context? Are consequences of a behavior influenced by what other individuals do?
- Can benefits and other consequences of a behavior be different between the short-term and the long-term? Is there a dilemma between short-term motivations of individuals and long-term benefit for everyone?

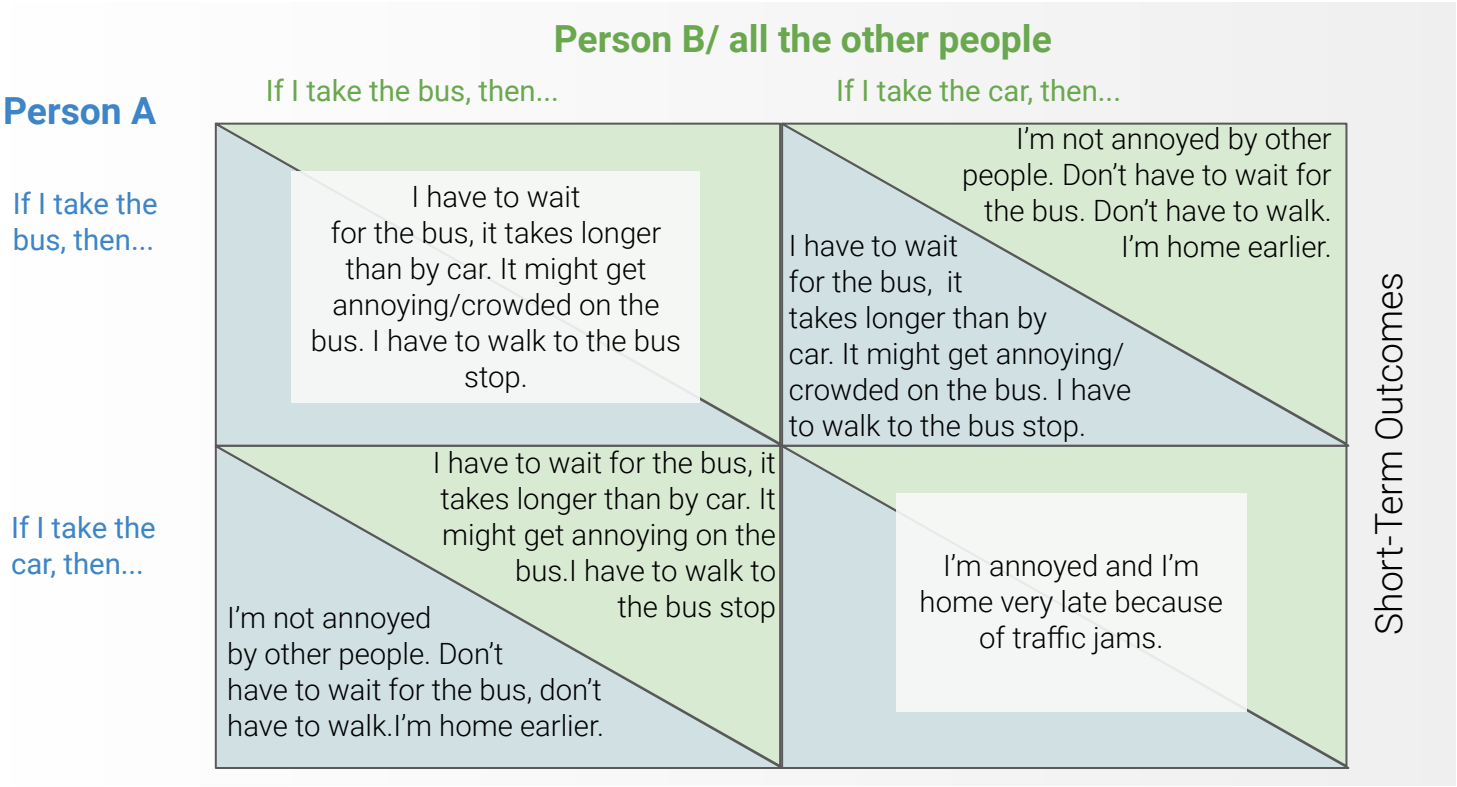


What motivates all these people to take the car? Why does no one take the bus?

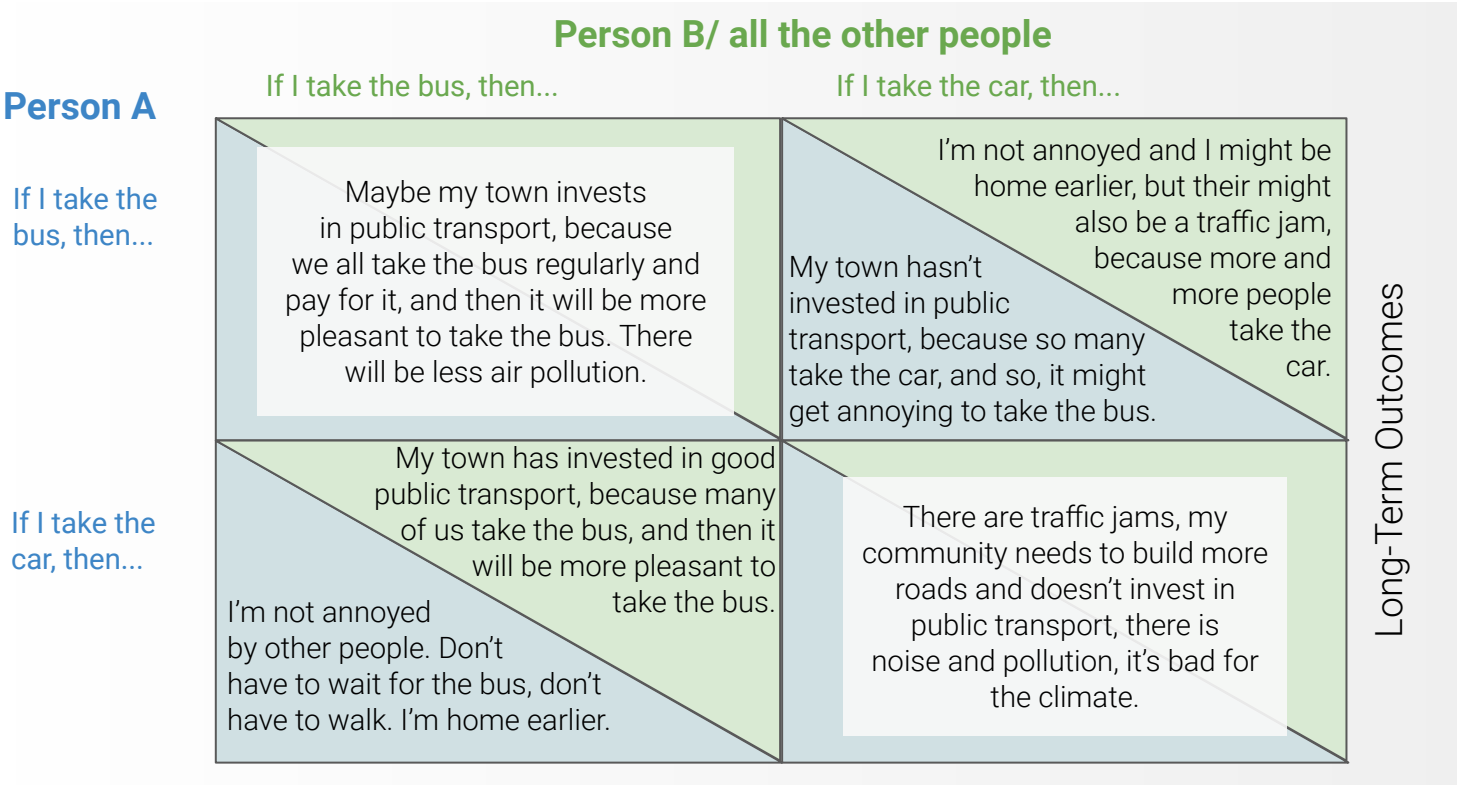
What is the outcome of everyone taking the car or the bus, in the short-term and in the long-term, for individuals, for the community, and for their environment?

Payoff Matrices

…. to explore the motivations and outcomes of human behaviors in particular situations.

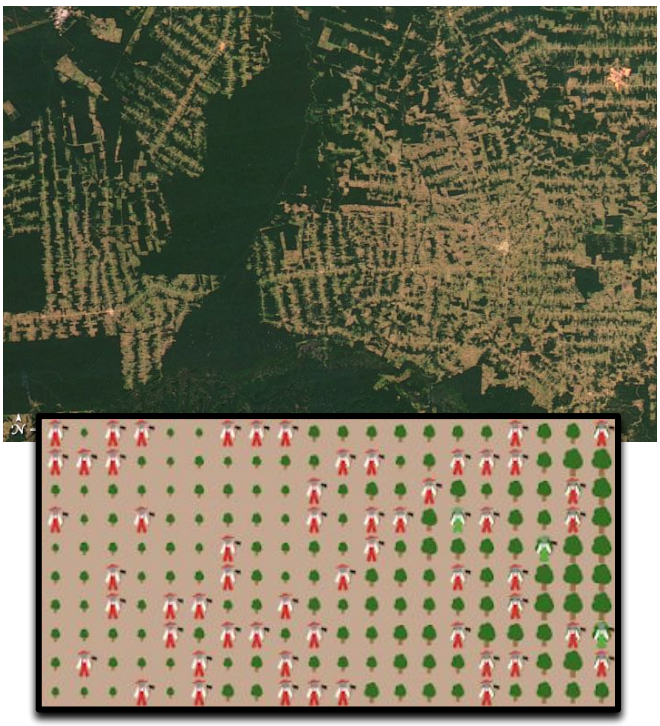


Is there a dilemma between the short-term motivations of individuals and the long-term benefits for everyone?



Payoff Matrices

.... to explore the motivations and outcomes of human behaviors in particular situations



What motivates people to clear forest for a field? Might individuals be motivated to clear a smaller patch of land than their neighbors? Why, or why not?

What are the outcomes of everyone's behavior in the short-term and in the long-term, for individuals, for the community, and for the forest?

What motivates players in the ultimatum game (→ p. 48) to keep all the money? What motivates players to share a fair amount to a stranger? What motivates the partner to refuse the offered amount? What are the outcomes of everyone's behavior?

Analogies and Analogy Mapping

... for the development of networked and transferable understandings

Explicit comparisons guide students to transfer their developing understandings to across content, including to everyday and societal issues. For example:

- What are the similarities and differences in the environmental conditions and characteristics of humans and other species?
- What are the similarities and differences in challenges to our ancestors' survival and today's challenges of sustainable development?
- What are the similarities and differences in the behaviors of people of different ages and socio-cultural backgrounds?
- What are the similarities and differences in the conditions of a behavioral experiment and the conditions in the real world?
- What are the similarities and differences in the evolution of living things and the present and future cultural evolution of humanity?
- What are the similarities and differences between different sustainability problems in the world and t different levels of society?

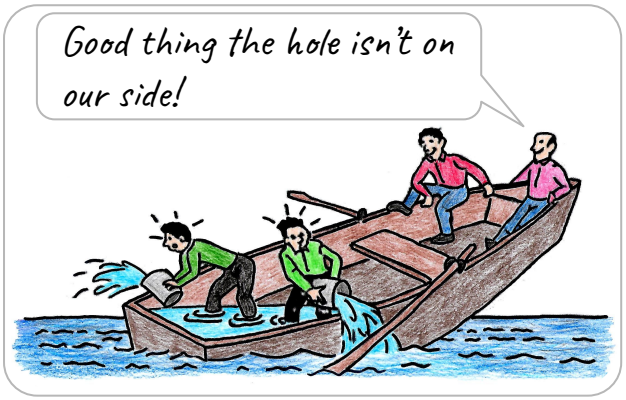
Analogy maps can help us to reflect on answers to these questions.

X (source analogy)	Relations	**Y** (target of explanation)
	Similarities	
	Differences	

Analogies and Analogy Mapping

... for the development of networked and transferable understandings

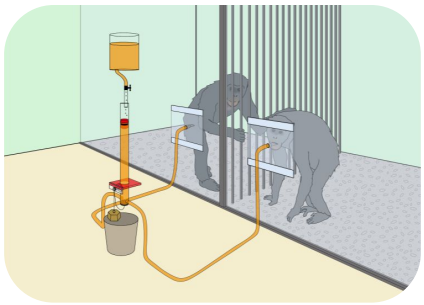
"All in the same boat"? → p. 3, 4

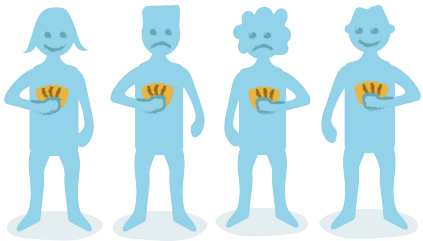


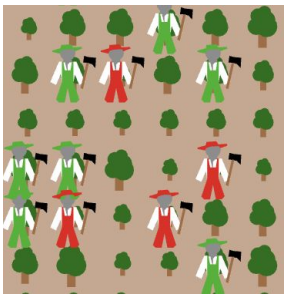
For any given sustainability question, we can ask: to what degree are we all in the same boat? To what extent are the interests of individuals in line or opposed? How can we align the interests of individuals with the interests of the community? Where does the boat analogy break down?

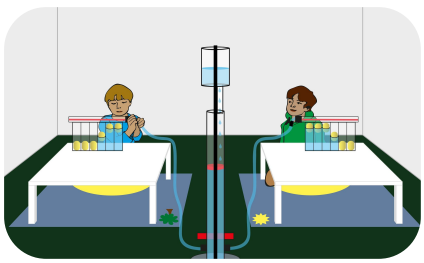
Experiments, cooperation games, computer simulations

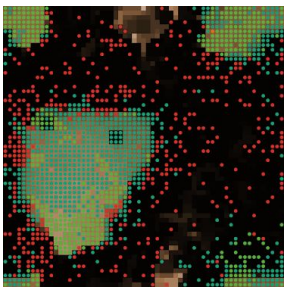
→ p. 46 ff. → p. 54 ff.









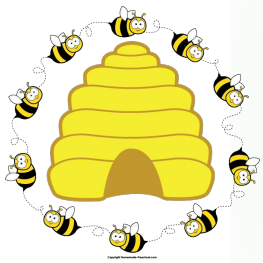


What are the similarities and differences in the conditions in experiments, cooperation games, models, and in the real world? Can we transfer these results to the real world challenges of sustainable development?

Analogies and Analogy Mapping

... for the development of networked and transferable understandings

Honey bee "Democracy"? → p. 20 ff.

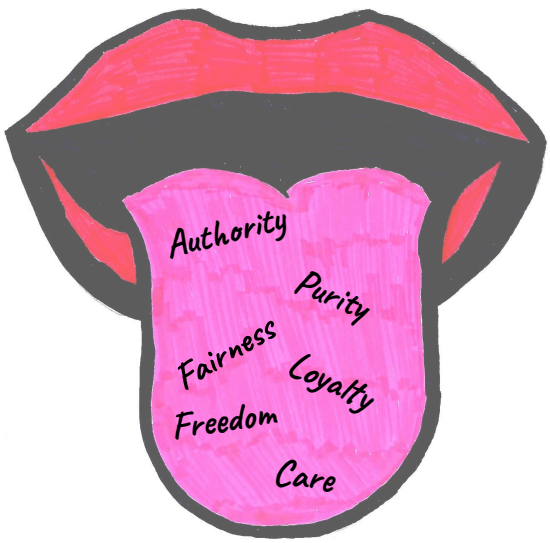


Principles for democratic decision-making:

- Common goal(s) or shared interests
- Low influence of a central leader
- Diverse and independent experiences and perspectives
- Open exchange of views
- Consensus building

What are the similarities and differences between the conditions, processes, and behaviors in the decision making of a honey bee colony and decision-making among human groups? How can we implement the principles of collective decision making in different human groups?

"Moral taste buds"? → p. 63 ff.



In what ways do the causes and functions of human taste buds resemble and differ from the causes and functions of human moral intuitions? Do these similarities and differences have implications for how we engage in discussions about sustainability dilemmas?

Analogies and Analogy Mapping

... for the development of networked and transferable understandings

Relating local and global sustainability problems

Ostrom's 8 Core Design Principles for Group Cooperation (→ p. 52):

1. Group identity and shared interests
2. Fair distribution of costs and benefits
3. Inclusive decision making
4. Monitoring
5. Graduated rewards and sanctions
6. Fast and fair conflict resolution
7. Group autonomy
8. Group relations

What are the similarities and differences in the conditions, challenges and opportunities for solving sustainability problems at different levels of society? How can we implement the principles of cooperation and sustainable resource management in different human communities?

Teaching Materials

Under the following links, you can find more information and teaching materials by theme based on our design concept.

Human Evolution

Information and teaching materials about the evolution and development of our human behaviors and other traits
http://human-evolution.globalesd.org

Present and Future

Information and teaching materials about the present and future causal relationships in our world
http://future.globalesd.org

Sustainability and Behavior

Information and teaching materials about sustainable management of common-pool resources and the role of human behavior
http://behavior.globalesd.org

Evolution on the Computer

Computer models and teaching materials about evolution, behavioral ecology and sustainability in social-ecological systems
http://netlogo.globalesd.org

OpenMind™

OpenMind™ is an education project of New York University. It integrates insights from psychology and evolutionary anthropology about our decision making, with the aim to foster in people a more open attitude towards those with different opinions. More information and teaching materials:
http://openmind.globalesd.org , https://openmindplatform.org

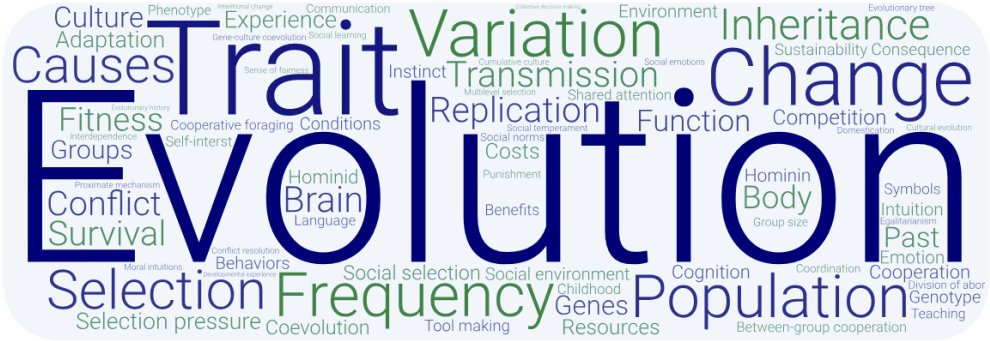
GlobalESD Youtube-Channel - Playlists by topic
http://youtube.globalesd.org

Example Unit Overviews

Unit on Human Evolution

... for the development of understandings and skills in human evolution

Concepts



Essential question examples (with concepts in bold)

- What **consequences** or **functions** does a **trait** have in a particular context for an individual and for its **environment**?
- What **causes traits** to **vary** in a **population**?
- How is a **trait inherited, transmitted** or **multiplied** within a **population**?
- What is the role of **behavior** in **evolutionary change**?
- What is the role of **genes** in evolutionary change?
- Under what **conditions** is it **beneficial** for organisms to live in **social groups**?
- What **traits** are **beneficial** for organisms who **depend** on living in a **social group** or need to **share common resources** with others?
- How do humans and human groups **acquire** and **change** their **beliefs, values, knowledge, technologies, norms, habits** and other **cultural traits**?
- What are the similarities and differences between the evolution of **genotypes** and the evolution of human **culture**?

Skills

- S1. Students will be able to use **Tinbergen's questions** as a tool to explore complex causality in human behavioral ecology.
- S2. Students will be able to construct **causal maps** to represent causal relationships between conditions, behaviors and other traits in the evolution and development of traits and populations.
- S4. Students will be able to compare generalized principles across content (e.g. experiments, models, traits) with the help of **analogy maps**.

Example Unit Overviews

Unit on Human Evolution

... for the development of understandings and skills in human evolution

Unit Lesson Plan Overview (example)

Initial reflection on the concepts of **evolution** and **behavior**, and their relationship

Context 1: Upright Walking

- Reflection and initial conceptual understanding on the role of environmental conditions, behavior, bodies and genes in evolutionary change
- Skills: Causal mapping

Context 2: Cooperative Foraging

- Reflection on which traits are beneficial for organisms who need to cooperate to obtain and share resources with others

Context 3: Tool making and tool use

- Reflection on how organisms acquire and transmit the behavior of making and using particular tools and technologies

Context 4: Life in groups

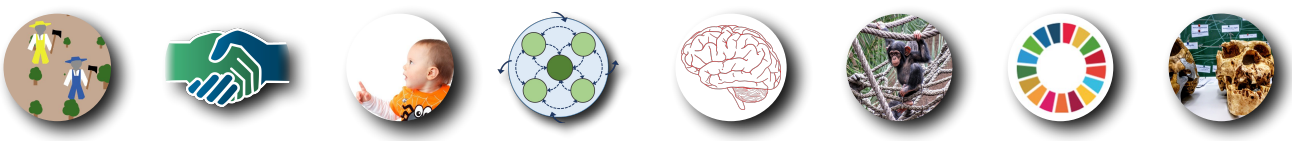
- Reflection on which traits are beneficial for organisms who depend on living in a social group or need to share common resources with others

Context: The Ultimatum and Dictator Game

Context: "Moral taste buds" / moral intuitions

Context: Computer simulations of evolution of populations

Flexible extension to further contexts/traits as by interest or subject area



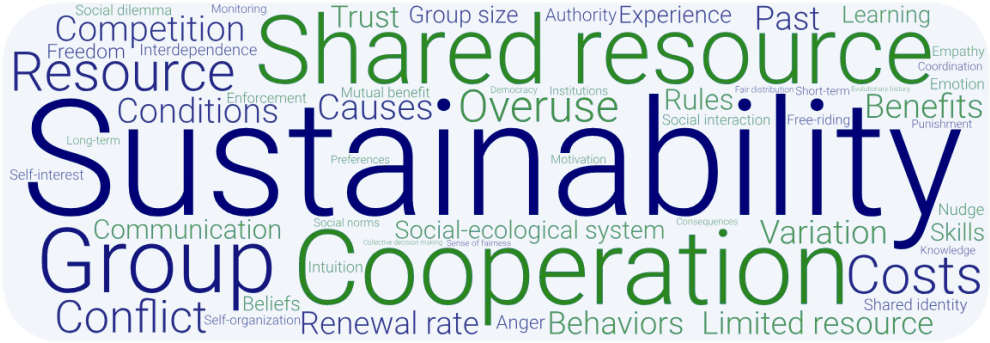
For more information and materials on this unit: http://unit-design.globalesd.org

Example Unit Overviews

Unit on Sustainability Science

... for the development of understandings and skills in sustainability science

Concepts



Essential question examples (with concepts in bold)

- What problems can arise when a **group** of people have to **share** a common **resource**?
- How can **conditions** and **behaviors** influence the development of a **shared resource**?
- What **conditions** help people to **work together** to use shared resources **sustainably**?
- What is the role of **intuitions** and **emotions**, **beliefs**, personal **preferences** and goals, and learned **social norms** in **motivating** people to **behave** in a certain way?
- In what situations are **consequences** of a **behavior** influenced by what other individuals do?
- Do **consequences** of a **behavior** differ between the **short-term** and the **long-term**?
- Do people always need to be **monitored** and threatened with **punishment** in order to **behave** in a way that **benefits** the whole **group**? Why, or why not?

Skills

- S2. Students will be able to construct **causal maps** to represent causal relationships between **conditions**, **behaviors** and other factors in the development of **social-ecological systems**.
- S3. Students will be able to represent the possible **motivations** and **outcomes** (costs and benefits) of human **behaviors** with the help of **payoff matrices**, identify the **scale of social interactions** and possible **social dilemmas**.
- S4. Students will be able to compare principles across content (e.g. experiments, models, real world sustainability issues) with the help of **analogy maps**.

Example Unit Overviews

Unit on Sustainability Science

... for the development of understandings and skills in sustainability science

Unit Lesson Plan Overview (example)

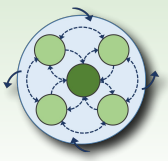
Initial reflection on the concepts of **sustainability** and **behavior,** and their relationship

Context 1: Cross-species and child development cooperation experiment

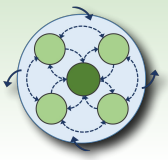
- Reflection and initial conceptual understanding on the challenges of using shared resources and cooperation
- Skills: Analogy Mapping, causal mapping

Context 2: Transfer to a real-world case study of shared resource use

- Reflection on how conditions and behaviors can influence the development of a shared resource
- Skills: Analogy mapping, causal mapping



Context 3: Transfer to another real-world case study of shared resource use



Context 4: Reflection on the concepts of **social interactions** and **social dilemmas,** extension of the concept of **sustainability** to everyday situations

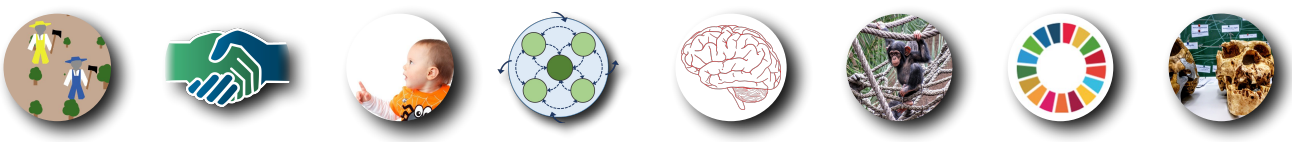
- Skills: Payoff matrix

Context: Experiment of real-world behavior change

Context: The Ultimatum and Dictator Game

Context: Computer simulation of resource use

Flexible extension to further contexts as by interest or subject area



For more information and materials on this unit: http://unit-design.globalesd.org

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More about Education for Sustainable Development and Global Goals

#TeachSDGs
http://www.teachsdgs.org/

United Nations Sustainable Development Goals (official site)
https://sustainabledevelopment.un.org/

Our World in Data
https://ourworldindata.org/
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MyWorld2030 - Global survey and results on people's priorities in sustainable development
http://data.myworld2015.org/
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More about (Human) Evolution Education

EvoKids
http://www.EvoKids.org

Ancient Ancestors
https://www.AncientAncestors.org

Human Evolution Teaching Materials Project
https://www.hetmp.com/

Big History Project
https://www.bighistoryproject.com

Smithsonian Human Origins Project
http://humanorigins.si.edu/

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More about applying these concepts for Social-Emotional Learning

Empower Forwards
https://www.empowerforwards.com/

The Matrix in the Classroom / Evolving Solutions
http://www.philtenaglia.com/matrix-education/
https://www.evolvingsolutions.co

More about applying these concepts to fostering cooperation

Prosocial: The Science of Working Better Together
https://www.prosocial.world

More about Conceptual Learning and Unit Design

Ed to Save the World. Materials, Resources, Books, Workshops, Blog
https://edtosavetheworld.com/

At GlobalESD: http://unit-design.globalesd.org

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If you find the Global ESD design concept interesting or would like to use our teaching materials in your classroom, please connect with us to discuss how you can best adapt these ideas for your school or classroom.

For more information and teaching materials, visit our website.

Global ESD
http://www.GlobalESD.org
Contact:
Susan Hanisch - Susan@GlobalESD.org
Dustin Eirdosh - Dustin@GlobalESD.org

Our German Partner Organization (*in German*):
http://www.EvoLeipzig.de

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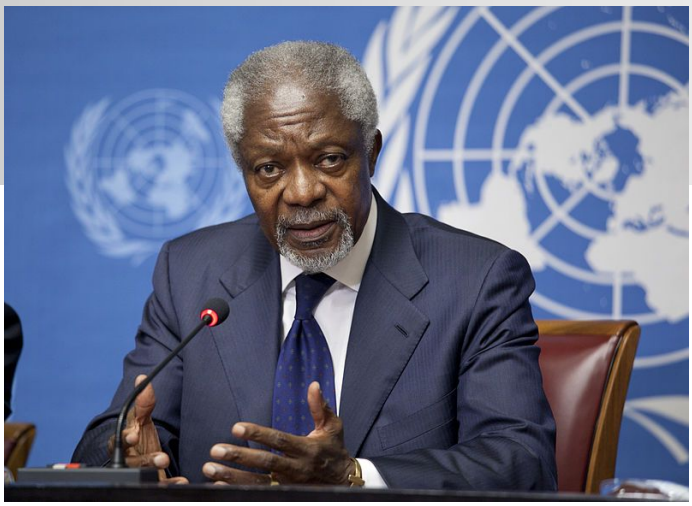
*“**No one is born a good citizen; no nation is born a democracy. Rather, both are processes that continue to evolve over a lifetime.** Young people must be included from birth. A society that cuts itself off from its youth severs its lifeline; it is condemned to bleed to death.”*

*“**Education is a human right with immense power to transform.** On its foundation rest the cornerstones of freedom, democracy and sustainable human development.”*

*“**More than ever before in human history, we share a common destiny.** We can master it only if we face it together. And that, my friends, is why we have the United Nations.”*

*“**To live is to choose.** But to choose well, you must know who you are and what you stand for, where you want to go and why you want to get there.”*



Kofi Annan,
Former Secretary General
of the United Nations

www.GlobalESD.org