AI 507 – Research seminar AI & Society

#RS2 from observation to theory

Associate Prof. Dr. Lena Frischlich

Flashlight

- I toss a ball– you tell me one keyword about what we did last week in the research seminar
- If you where not there – pass the ball
- Helps deep encoding and activating the relevant neurons in your brain

In sum

How

Organisation/
Formal frames

Why

Value of teamwork

Trustworthy science

What

Social Science

- Descriptive vs. normative
- Not all created equal
- Ideal research circle

Open science

What are your questions so far?

Then I hope,

at the end of today's lesson, you will…

- ❑ … have heard some reasons for why theories help us to become better scientist
- ❑ … know what concepts and constructs are and how they become useful for scientists
- ❑ … have discussed what a scientific theory is – and what not
- ❑ … known what distinguishes research questions and hypotheses from each other
- ❑ … have some criteria for how good research questions/ hypotheses
- ❑ … learned some tricks how to find research questions

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What is a theory?

Theories are inextricable linked to science (

- Science comes from the Latin term *scire (= "to know")*
- *Sciens* is the present from, meaning "knowing"
- In short: Science it is a particular way of knowing something
- Distinct from other ways of knowing such as intuition, authority or religious beliefs
- Some people believe that science is at odds with other ways of knowing and there is only one correct way to "know"
- But: science and other ways of knowing are not totally incompatible (and one is not always better)
- One central difference is that science is constantly questioning itself
- That holds for both social and natural sciences – and theory matters for both

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Theories are inextricable linked to science

- Theory comes from the Greek term *theoria (= "to look at")*
- We all use theories all the time!
- We all have lay theories on the world works, how to choose a mate, how to ask someone for a date
- A theory is simply our understanding of how something works
- As long as our observations/ experiences fit to our (lay) theories – we rarely tend to question them
- That is a bit different in science – the goal of science is to produce and test theories
- We make our theories explicit, formulate precise statements, test and evaluate them

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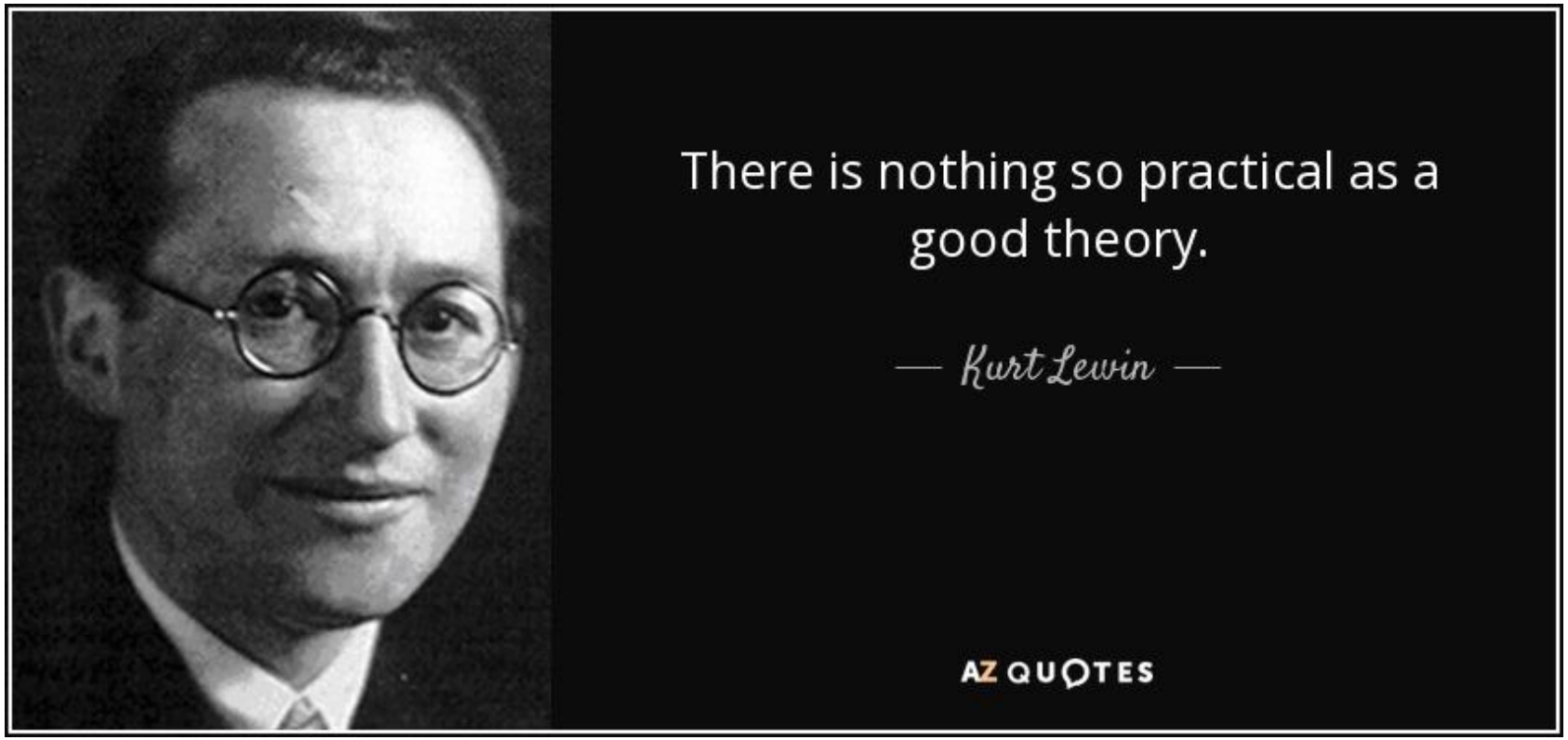
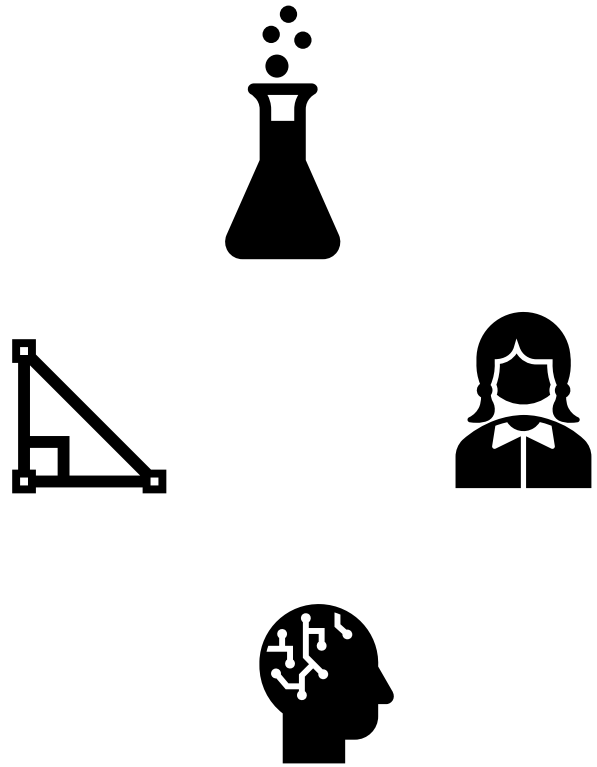
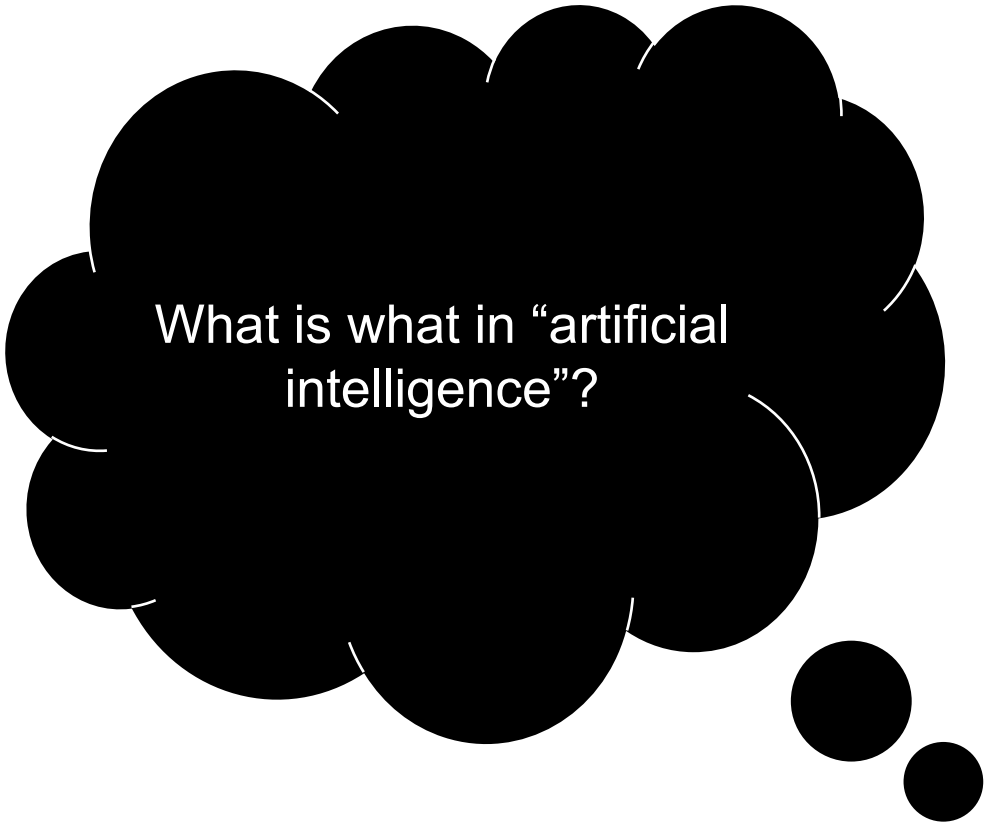
We use theories to describe, explain, and ultimately predict the future





But what is in a scientific theory?

- Theories consist of **constructs** (= abstract) and **concepts** (= more concrete)
- They become measurable as **variables**
- E.g., mass media use = abstract construct
- Includes specific concepts such television exposure, newspaper exposure, radio exposure etc.
- Measurable variables can include days per week spend with watching television, number of minutes per day, which programs someone watched etc.



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Different types of variables

- **Categorical variable**: A is different from B – but not necessarily better (e.g., men versus women, AI versus service worker)
- **Ordinal variable**: A is different from B and C – ABC are ranked, but they are not “equidistant” (A is MUCH better than B, but B only slightly better than C) – typical for grades, education etc.
- **Parametric variables:** A is as much better than B than B is compared to C – typical for scales, age, body size etc.

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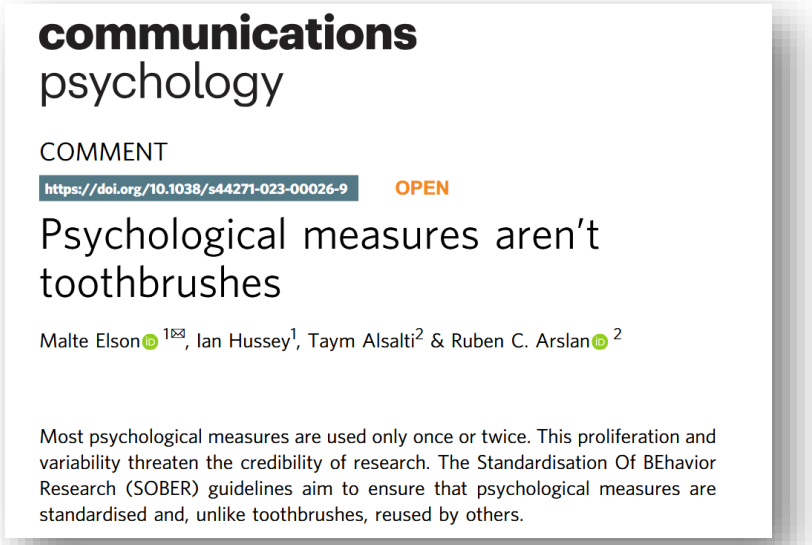
What makes a construct scientifically useful?

- Precise formulation
- Measurable variables
- Measures are grounded in prior measures – deviations are justified



communications psychology

COMMENT

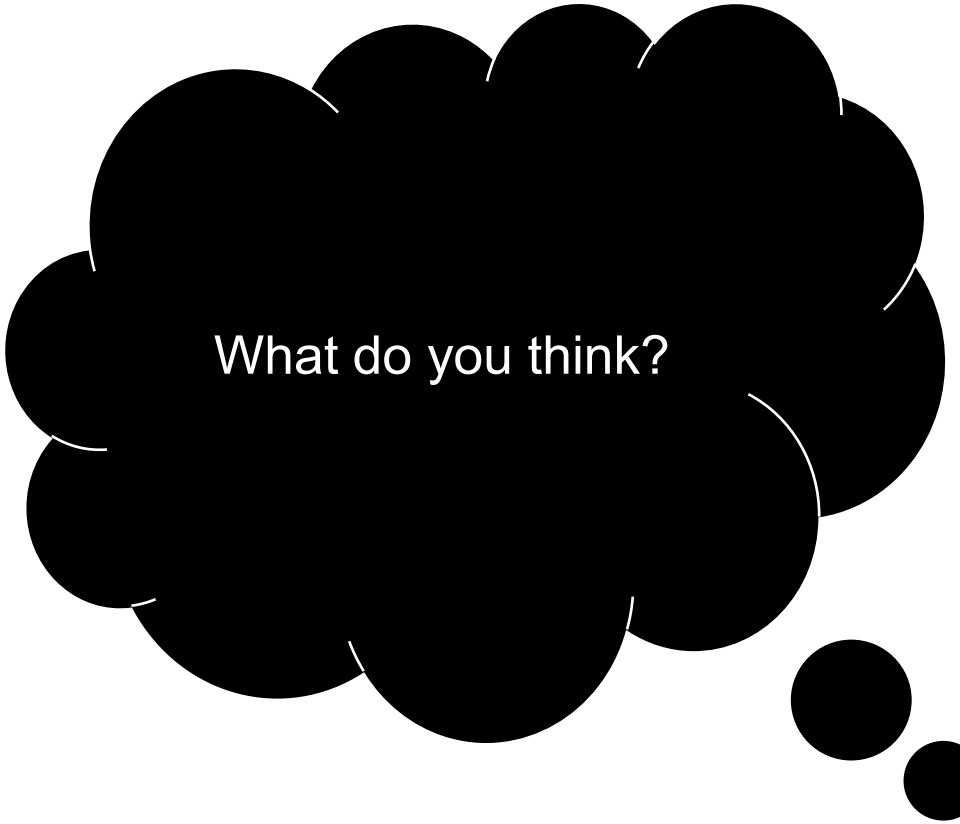
https://doi.org/10.1038/s44271-023-00026-9 OPEN

Psychological measures aren't toothbrushes

Malte Elson[1✉], Ian Hussey[1], Taym Alsalti[2] & Ruben C. Arslan[2]

Most psychological measures are used only once or twice. This proliferation and variability threaten the credibility of research. The Standardisation Of BEhavior Research (SOBER) guidelines aim to ensure that psychological measures are standardised and, unlike toothbrushes, reused by others.

Replicability crisis (#RS1)



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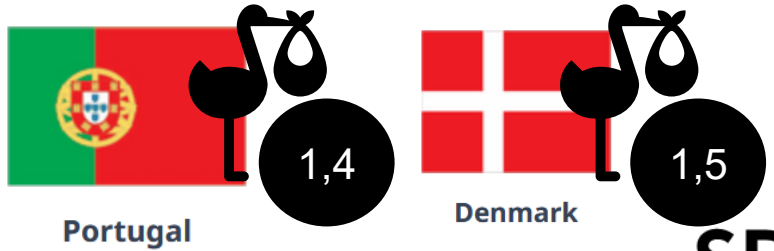
What are your questions so far?

A theory alone is not enough – you also have to test it!

Establishing causality

- Theories generally are aimed at establishing causality, (i.e., that one thing causes another and not vice versa)
  → predictions of the future
  - Cause = independent variable
  - Consequence = dependent variable
- These relationships are formulated in **hypotheses**
- Not all hypotheses are causal though – some are also **correlational**, that is they assume that two (or more) concepts co-occur, but not that one causes the other



https://data.worldbank.org/ Fertility rate, total (births per woman), 2023

When can we test a theory?

- Theories become testable when we test the relationship between two (or more) variables
- Not all constructs are a variable – e.g., alive = constant (yes/no), lively is a variable (more/less)
- We need to formulate the relationship in a theoretical statement
  a. **Hypothesis:** a testable statement about the relationship between two or more concepts (variables) – can relate to differences A> B or relations A+ →B+
  b. **Research question:** an open question about the relationship between two or more concepts
- Can be distinguished from
  - **Propositions** are merely descriptive and provide information about only one variable at a time – less useful than hypothesis
  - **Assumptions:** A theoretical statement that is taken for granted (or untestable). May describe the relationship between variables (similar to a hypothesis), or the usual value of one (as in propositions).

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What is what? Raise your hands!

1. AI will help humanity to thrive
2. I show you a statement and go through the list – you raise your hand, when I "hit" the correct label
3. People with a higher AI-literacy trust AI-based systems more than people with a lower AI-literacy
4. How does the daily use of AI change authors understanding of creativity?
5. Societal power dynamics are inherent in the architecture and trainings data of AI-systems
6. Most Danish students have experiences with using AI for their academic tasks
7. AI is an inevitable part of future education

a) Hypothesis (predicted relationship)
b) Research question (open)
c) Assumption (untested/ untestable)
d) Proposition (description)

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Be aware of your own assumptions!

- What is your own set of beliefs and assumptions about the topic you are studying?
- What do you consider “general knowledge” (and does really everyone agree?)
- What is belief (i.e., assumptions) – what has been tested?
- E.g.,
  - Capitalism is the best economic system
  - Men are better hunters than women
  - Lord of the Ring is the best movie of all times
  - The more information people have about political candidates the better

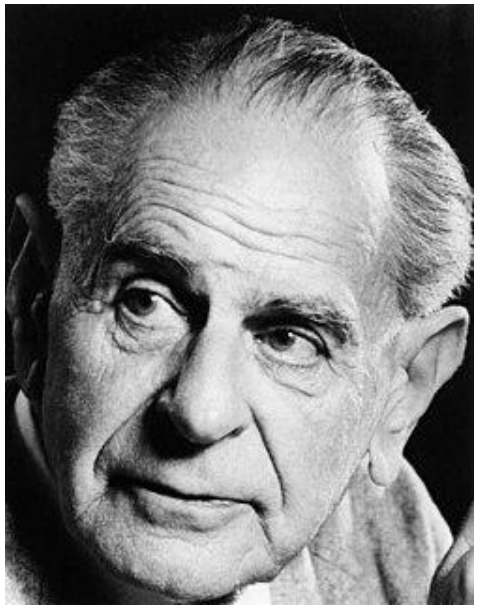
What everybody knows might, in fact, be incorrect!

- The less assumptions a hypothesis needs – the better it can actually tell us something about the world (→ *Ockhams razor*, the simplest solution is the best)

How are hypotheses tested?

The principle of falsification

- Basic distinction between scientific theories and – for example – conspiracy theories is the principle of **falsification**
- Based on the observation that verification can be hard – the case of unicorns
- Thus, we always only approach the truth – we formulate strong predictions that future evidence might reveal to be false
- Repeated strong tests that fail to falsify our hypotheses increase the believe in the hypothesis (till at some point it doesn't practically matter that much anymore)



Karl Popper
via LSE library - https://www.flickr.com/photos/lselibrary/3833724834/in/set-72157623156680255/

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Difference to conspiracy theories!

Some people around the world believe our planet is flat. Here's the (surprising) truth about debating them. (Image credit: kevron2001 via Getty Images)

DTU ØRSTED LECTURE

Andreas Mogensen - live from the International Space Station

DTU invites neighbors, high school students, students, and staff to a lecture with astronaut Andreas Mogensen from the International Space Station.

Andreas Mogensen gives a status of his experiences and preliminary results from some of the research projects he carries out for DTU. Photo: ESA/NASA.

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Time for a break

Embedding a theoretical statement in your research circle

Theoretical statements have to be linked – both to their roots and to their tests

- Two types of linkages
- **Theoretical linkage**: explains why the hypotheses, assumptions, and propositions should be true, using at least one of three methods.
  - Cite an existing theory and all of the explanations inherent in the theory
  - Cite literature can be cited that shows results similar to those predicted by the hypothesis
  - Researchers must be able to state support for the hypothesis in their own words using their own logic – if you do not know at least 10 logical reasons for why you should be right, it is unlikely that you are

Exercise: Two truth and a lie

- Take 5 minutes to discuss with your neighbour the logic/ evidence for the following three statements: Come to a joint conclusion: What is the lie?
- Defend your conclusion

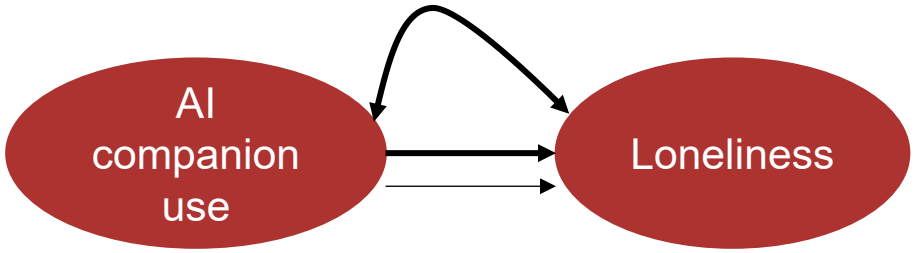
(1) The use of AI-based hiring systems reproduces existing social inequalities, even when protected attributes (e.g. gender or ethnicity) are excluded from the model

(2) AI systems deployed in society shape human behavior even when humans formally remain “in the loop” as final decision-makers

(3) When humans remain formally responsible for decisions made with AI support, automation bias cannot occur, because the final choice is made by a human actor

Theoretical statements have to be linked – both to their roots and to their tests

- Telling how the variables in the hypothesis are related is the job of the **operational linkage**
- Can be graphical (actually amazing for thinking)
- What is
  - The type of relations (linear, curvilinear etc.)
  - Direction of the link (positive/ negative)
  - Size of the relations (e.g., coefficient/ slope)
  - Limits of the relations (e.g., ceiling effect)
- Informs the statistical formulation of the linkage



How to find a research question/ hypothesis to test?

There are *many* different ways of finding a scientific problem – at least 49 heuristics

1. **Sensitivity to provocative natural occurrences** (recognizing odd stuff, introspection, retrospective comparison, sustained observation)
2. **Simple conceptual inference/ direct inference** (conversions of a banal proposition, conceptual division, jolting one's conceptualizing out of its usual ruts)
3. **Complex conceptual inference/ indirect inference** (deductive reasoning, meta-theories, though diversification)
4. **Past research** (reading past studies closely, integrating multiple past studies)
5. **Collecting new data → Next week**

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Brainstorming

- Formulate potential scientific problems (aka research questions and hypotheses) around AI and Society
- Do not judge your ideas
- Put one after the other your idea on the wall
- Do not stop, even if you think you have no more ideas – try another method but keep generating ideas about knowlegde gaps
- Do not judge each other

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Have a wonderful rest of the day!

Associate Prof. Dr. Lena Frischlich

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