Heidelberg University

LERU Doctoral Summer School in Heidelberg 2023 / Draft

Concepts of intervention science applied to global challenges

Equipping the next generation of scientists with understanding of main concepts and methods of intervention science and applying them to the converging global challenges: climate change, pandemics, and societal injustice

“What starts out as science fiction today may wind up being finished tomorrow as a report."
Norman Mailer

Theme

Societies today face multiple and highly interwoven global challenges such as accelerating climate change, antimicrobial resistance, food and water security and safety, pandemics of infectious and non-communicable diseases, and social injustice. Threatening to converge, these global challenges call for the effective and timely transformation of societies worldwide to ensure that we continue to thrive.

Science can massively contribute to tackling these challenges, by discovering, co-designing, and evaluating solutions. While not yet commonplace, a *science of intervention* is increasingly urgent. The COVID-19 crisis has dramatically demonstrated the scientific success of basic science – with rapid developments of both COVID-19 tests and vaccines – and the failures of real-life deployments of these efficacious technologies. Societies have proven susceptible to division, polarization, political tension, and many individuals have been unable or unwilling to follow intervention and policy prescriptions. A science of intervention can avoid such failures by contributing robust and transferable knowledge on what works and what does not in real-life intervention design and deployment.

The LERU network in general, and Heidelberg University in particular, aim to prepare future scientists and societal leaders to tackle global challenges and facilitate interdisciplinary research, innovation, and communication. In this summer school, we propose to explore a science of intervention, particularly we propose to convey conceptual knowledges of *practices and methods* to identify intervention need, design interventions, and establish their impact, performance, and social value. The scope of this summer school is framed by the concept of a T-shaped scientist. In this concept, the horizontal bar of "T" represents the breadth of skills, and the vertical bar symbolizes the depth in one area. In this summer school, we will stay on the horizontal bar of "T" and convey broad general knowledge of the methods of intervention science rather than their execution. Equipped with a conceptual understanding of methods and insights on how to choose the methods given a research question, participants can develop expertise further in their research.

The Heidelberg LERU Doctoral Summer School will bring together doctoral students from LERU universities, scientists and scholars of Heidelberg University – including from the Heidelberg Institute for Global Health (HIGH), Interdisciplinary Center for Scientific Computing (IWR), and Heidelberg Institute for Geoinformation Technology (HeiGIT) – and external speakers, to share expertise and experience with scientific practices of a science of intervention. We will focus on the conceptual understanding of the intervention science methods and discuss them in the context of three major themes– climate change, pandemic prevention, and social injustice – but the summer school will encourage participants to insert case studies and examples beyond these three challenges for discussion.

The three challenges provide many opportunities to understand and discuss the concepts of the methods applied to discover, design, and test interventions. Discussion questions will include the following: What is the need for an intervention, and whose needs are most urgent? How should we approach the design of an intervention, so that it is feasible, viable, and desirable in a particular local context? What methods are applicable to estimate the causal impact of an intervention when it is deployed in real-life? What can we use when we want to elicit the modes and contexts of intervention action?

We will facilitate the discussion of the methodological concepts of the intervention science within context of three global challenges and show how these concepts can be applied in these domains.

Societal challenge I: climate change

Anthropogenic climate change triggers adverse effects on global ecosystems and human health (Romanello et al. 2021). It has given rise to systemic adverse threats to humanity, manifested through alterations and intensification of extreme weather events, increased sea levels, crop yield failures, and changes in the ecology and distribution of infectious diseases (Kumar et al. 2021). Adding to these existing impacts, the risk of crossing over the climate tipping point is increasing. Reaching this threshold may well happen before average global warming reaches 2°C (Collins et al. 2022) and lead to widespread disruptions in natural and social systems. The acceleration of climate change and the multifactorial nature of associated impacts emphasize the need for a more proactive and holistic approach to mitigation and adaptation actions. Mitigation interventions aiming to reduce global warming include energy transition to renewable sources, energy-efficient building design and infrastructure, promoting climate-friendly diets, encouraging more active mobility (walking and cycling), and protecting rainforests, which act as critical carbon sinks. These interventions can slow down or even reverse changes in frequency, intensity, and geographical distribution of climate determinants of infectious disease emergence and spread (Rocklöv and Dubrow 2020), nutrition (Romanello et al. 2021), extreme weather events, and heat waves. Adaptation interventions are critical to cope with the current and future climate variability and include the adaptation of the cities and rural areas to heat waves and extreme events (Lin et al. 2021), the transformation of agricultural practices (Harwatt et al. 2020), and a wide range of individual- and household-level behaviour changes.

The Heidelberg LERU Doctoral Summer School will explore how the different methodological concepts of a science of intervention can contribute to the social transformations, including structural and behavioural changes, needed to mitigate and adapt to the effects of climate change. We will invite the participants to propose interventions, and then jointly discuss possible methods to discover, design, and test these interventions. We will encourage interdisciplinary thinking, for example, asking questions such as “How can network science elucidate the transmission of intervention impact across physical and social networks?” We will show the participants what methods can be used to establish intervention effectiveness in terms of mitigation and adaption

outcomes. For example, we will convey the concepts of the methods applied to design and evaluate passive cooling technologies to help vulnerable people protect themselves against extreme heat.

Societal challenge II: pandemic prevention

Emerging infectious diseases pose another global threat to human health and economies worldwide (Bernstein et al. 2022). The COVID-19 crisis, unfortunately, has proven that contemporary global societies are highly susceptible and unprepared to effectively and cohesively manage global outbreaks. Infectious disease pandemic prevention and preparedness present important tasks for global societies. Non-communicable diseases such as obesity (Hepatology 2021) and diabetes (Singer et al. 2022) are other ongoing 'pandemics', causing considerable disease burdens and often interacting in important ways with infectious diseases (Chikowore et al. 2021). The Heidelberg LERU Doctoral Summer School will introduce how the methods of intervention science can support evidence-based decision-making to prevent existing and future pandemics of communicable and non-communicable diseases. We will explore, for example, the examples of design and testing interventions to change the human structures and behaviours that lead to zoonotic spillover of viruses.

Societal challenge III: social injustice

Climate change, communicable and non-communicable diseases, and other societal threats (such as food and water crises) will affect vulnerable and marginalized populations particularly severely (Aschner et al. 2021; Ziegler et al. 2017). It is thus imperative to design interventions so that they are responsive to the needs and preferences of vulnerable and marginalized populations. It is also important to measure the distributions of intervention impacts across important social dimensions – and to judge the normative meaning of unequal distributions. The Heidelberg LERU Doctoral Summer School will discuss how interventions relate to the existing distributions of opportunities in societies, and what these distributions mean for intervention impact and value. We will also explore the methods of design research to ensure that interventions are viable and desirable for particular groups of vulnerable people, such as migrants and refugees, older adults, and the physically or cognitively impaired.

The instructors of the Heidelberg LERU Doctoral Summer School will focus on the concepts of the intervention science methods using the example of interventions applied in the fields of these three societal challenges. At the same time, they will encourage the participants to "bring their own challenges" and to think about the methods which could be applied to design and evaluate potential solutions.

Further, we will facilitate group work with an expert functioning as a mentor providing the participants with opportunities to communicate with the experts and network.

Heidelberg University

Heidelberg University, officially the Ruprecht Karl University of Heidelberg, was founded in 1386 and is Germany's oldest university. Heidelberg is a German Excellence University and occupies top positions in international rankings. A central component of its strategy is the concept of the *Comprehensive University*, with researchers working across disciplinary boundaries to solve some of society's most pressing problems. The thematic and methodological foci of HIGH, IWR and HeiGIT are key components of this strategy.

Heidelberg City

Heidelberg is a city in southwest Germany, situated on the river Neckar and surrounded by mountains. It provides plenty of opportunities for social, cultural and outdoor activities. It also boasts several strategies and structures addressing major societal challenges, such as an innovative mobility concept, scientific engagements with citizens and university scholars, and an emerging living lab.

Objectives of the summer school

The Heidelberg LERU Doctoral Summer School is designed to offer early career scientists an overview and insight into the methods of intervention science giving examples from the domains of climate change, pandemic prevention, and social injustice. We will focus on the conceptual understanding of the methods within *five related practices of a science of intervention*: (i) identifying need, (ii) creating design, (iii) establishing impact, (iv) elucidating performance, and (v) determining value (**Figure 1**).

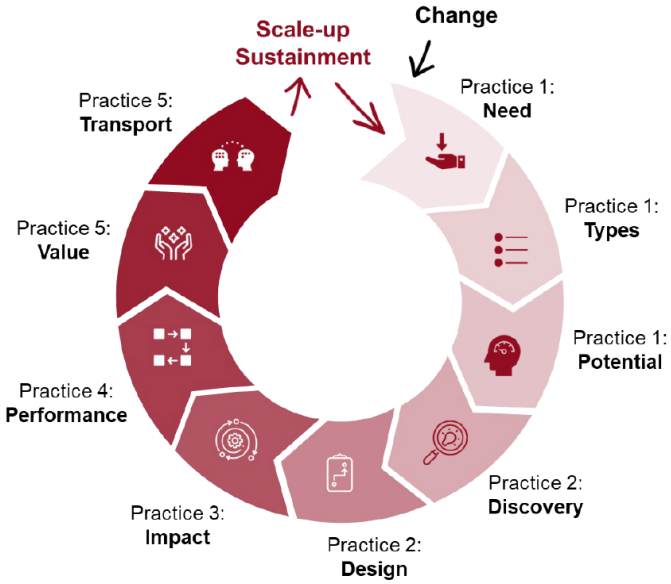

Figure 1: Five practices of intervention science

This summer school aims to accentuate the benefits of integrating methods from different disciplines into a coherent and practical logic of intervention science, with statistical methods from epidemiology and computer science, qualitative methods from ethnography, creative methods from design research, and causal methods from medicine and economics. The school will equip the participants with a coherent conceptual framework of intervention science. Further, we aim to contribute to the soft skills of the participants focusing on the development of a research idea and the art of pitching ideas to position the research against others.

In the mornings, we will cover theory and the concepts of the methods. For practical, interactive discussions, group work and networking, we will devote the afternoons of each of the five days of this summer school to practical sessions: (i) work in small groups with the summer school instructors discussing the methodological concepts and their potential application to one of the three societal challenges; and (ii) jointly work on a research idea and pitch for potential interventions and methods to study them to tackle the most pressing societal challenge.

Expected learning outcomes

Once the students have successfully participated in the Heidelberg LERU Doctoral Summer School they will be able to:

- Understand and recall practices of intervention science (to identify need, create designs, establish impact, quantify performance)
- Understand the advantages and disadvantages of several methods of intervention science
- Select particular methods within these practices for the scientific study of interventions
- Work within an interdisciplinary scientific team to identify opportunities for intervention design and testing
- Pitch a research idea to distinguish their study from others

Expected Outcomes

The active and interactive work during the summer school will produce concrete starting points for scientific studies of interventions addressing major societal challenges. During these sessions, which will follow the theoretical and methodological morning sessions, the participants will be asked to (i) think and develop a research idea for a potential intervention, (ii) select at least one intervention science method, (iii) identify the most important advantages and the most important disadvantages of the methods. Together, the summer school participants and instructors will also work on a research study idea, pitching it in different formats and practice their pitch to an audience.

Participant requirements

Candidates for the summer school are nominated by their home institutions. This summer school does not restrict the scientific field of the participants and welcomes applicants from a broad range of disciplines. The participants should be advanced in their doctoral project and have a strong motivation for a science of real-life interventions. Candidates must be available for the entire duration of the summer school. As all sessions will be conducted in English, fluency in both spoken and written English is required.

The target number of participants is 46.

Provisional program

Prior to the course week, we will engage participants by offering preparatory readings for each of the five practices of intervention science (**Figure 1**).

Time	Event	Program Partners/ Instructors
Sunday		
Evening	Opening Dinner	
Monday		

Practice 1 – identifying need		
Morning	Lecture series will cover theories and methods relevant to identifying intervention needs, including from more quantitative disciplines, such as epidemiology, demography, economics, computer science and machine learning, and more qualitative disciplines, such as ethnography and design research. This practice will cover approaches to identify types and clusters of intersecting health risks and syndemic disease burdens, as well as simulations to predict intervention potential given local need.	Ina Danquah, Joacim Rocklöv
Afternoon	• Lecture on the development of research ideas and the art of pitching ideas • Dividing in groups, finding expert mentors and networking	Till Bärnighausen
Tuesday		
Practice 2 – creating design		
Morning	Lecture series will cover theories and methods from design research, focusing on the creative and early testing stages of intervention discovery and design	Shannon McMahon, Alexander Zipf
Afternoon	• Discussion of the methods within the groups and exchange with the experts • Joint group work on research ideas and pitch	
Wednesday		
Practice 3 – establishing impact		
Morning	Lecture series will cover the theories, practices of methods of real-world randomized controlled experiments and non-randomized quasi-experiments. This practice will also include novel approaches to measuring exposures and outcomes, such as online platforms, citizen science, and crowdsourcing	Aditi Buncker, Till Bärnighausen
Afternoon	• Discussion of methods within the groups and exchange with the experts • Joint group work on methods related to the research idea and pitch	
Thursday		
Practice 4 – elucidating performance		
Morning	Lecture series will cover the methods and practices of theory-driven mixed methods performance (or process) evaluation to understand intervention contexts and mechanisms of action	Michel Wensing, Claudia Denkinger, Connie Ho
Afternoon	• Discussion of the methods within the groups and exchange with the experts	

	• Joint group work on methods related to the research idea and pitch	
Friday		
Closing session		
Early morning	Wrapping-up session	Till Bärnig-hausen, Claudia Denkinger, Joacim Rocklöv
Late morning and afternoon	• Pitching and discussing the research ideas to a larger audience including the participants and internal and external experts	All
Evening	Departure	

A social program will be developed. It will include a walking tour on the Philosophers' Walk and visiting the old town of Heidelberg.

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