How can environment-behavior studies contribute to enhancing societal resilience to disasters, including pandemics?

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Natural disasters in Japan

Typhoon

Flooding

Earthquake

Tsunami

Volcanic eruption

Major technological disasters

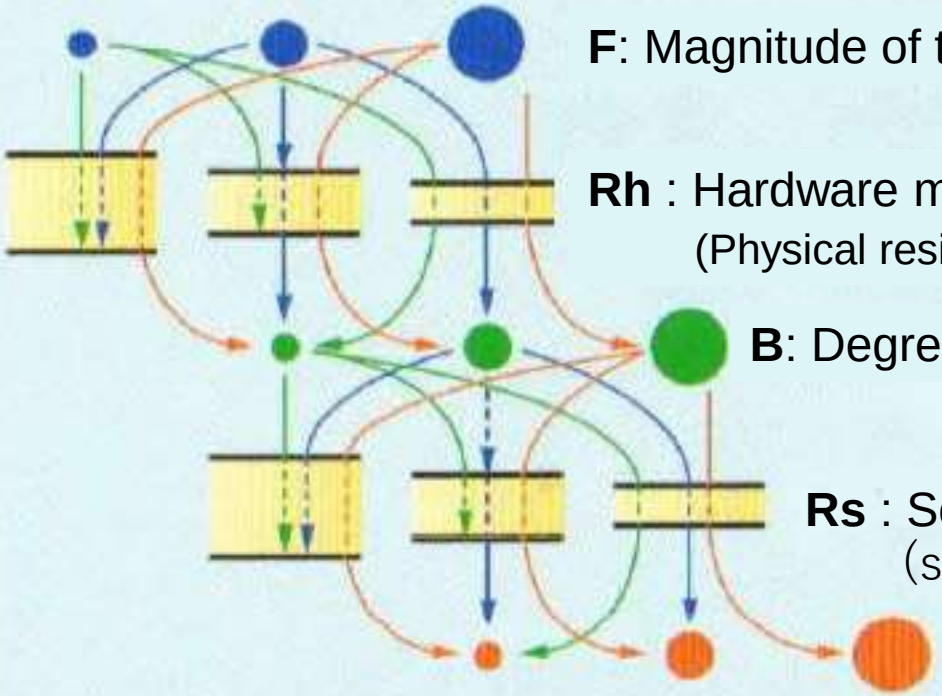
- Pollution by chemical substances (Ashio Copper Mine Poisoning Incident, 1891)
- Radiation leak accident (Fukushima Daiichi Power Station , 2011)
- Global Atmospheric Anomalies (Global warming)
- City fire (Great Fire of London, 1666)
- Traffic disaster (Japan Airlines jumbo plane crash, 1985)
- Pandemic (Plague, mid-14th century; Covid-19)

Fukushima Daiichi Power Station , 2011

Japan Airlines jumbo plane crash, 1985

Great Fire of London, 1666

Determinants of the magnitude of disasters



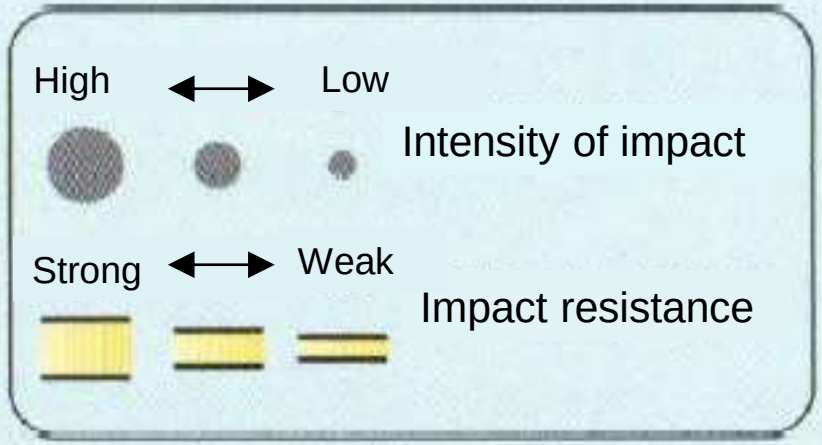
F: Magnitude of the impact of the natural force

Rh : Hardware measures for disaster prevention
(Physical resistance)

B: Degree of deformation of the built environment

Rs : Software measures for disaster prevention
(social systems and human behavior).

D: Magnitude of a disaster



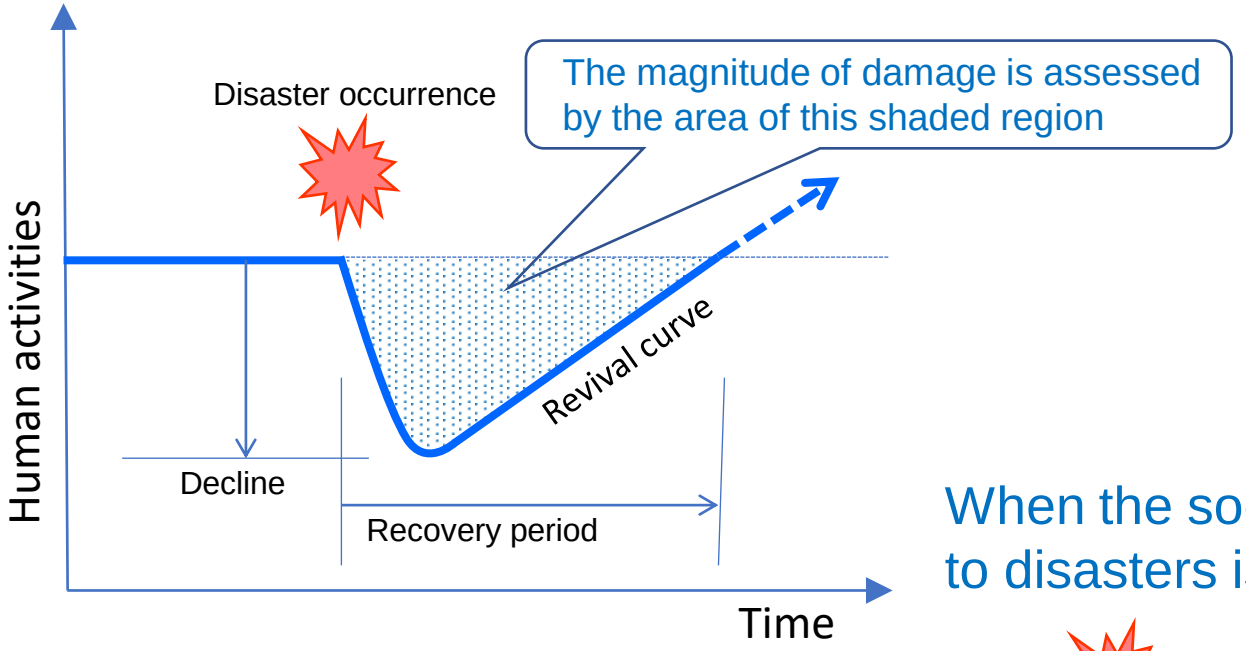
$D=f(F, Rh, Rs)$

Importance of software measures for disaster mitigation

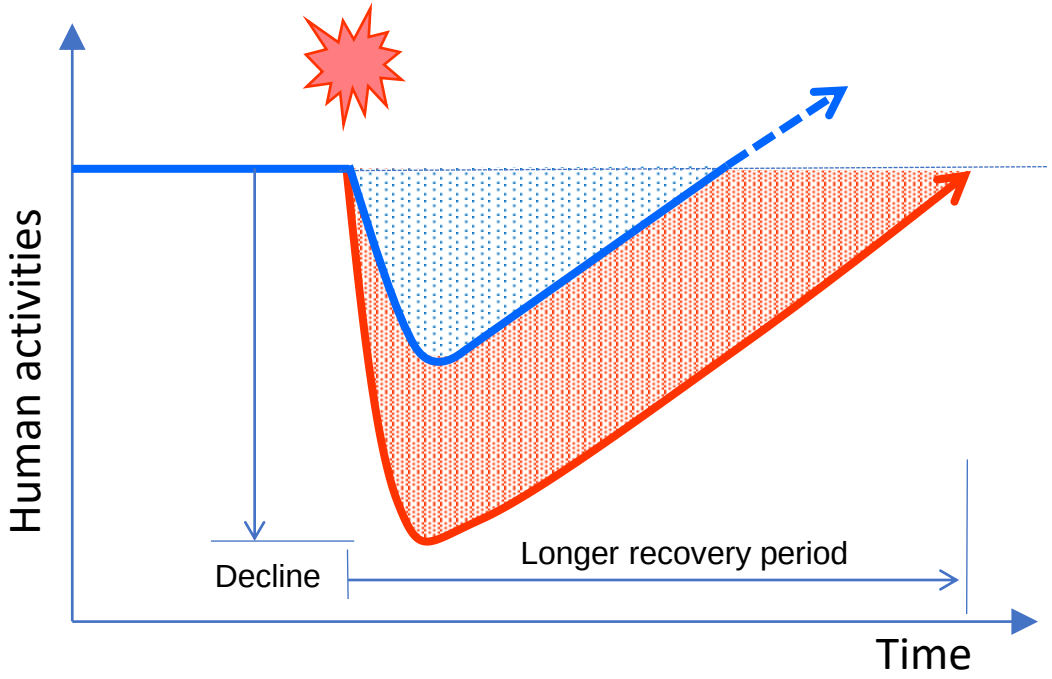
Courtesy of Taro-cho Fishery Cooperative Taro-cho

Taro-cho, Iwate prefecture

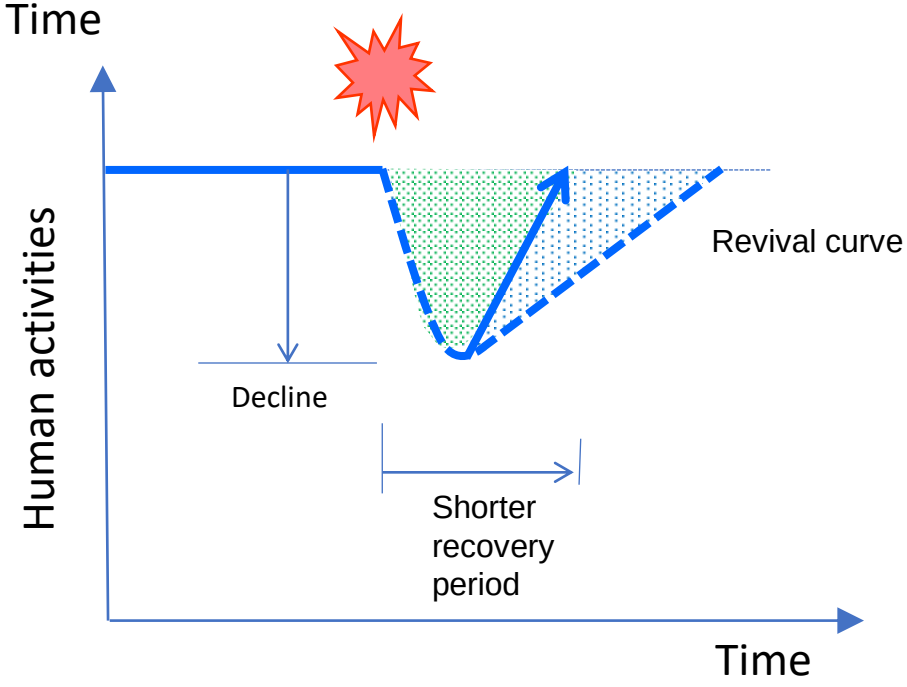
Resilience to disasters



When the built environment is vulnerable



When the societal resilience to disasters is greater



Characteristics of human behavior related to disasters

If appropriate actions are taken before, during and after a disaster, damage can be minimized. To this end, it is important to understand the characteristics of human behavior related to disasters.

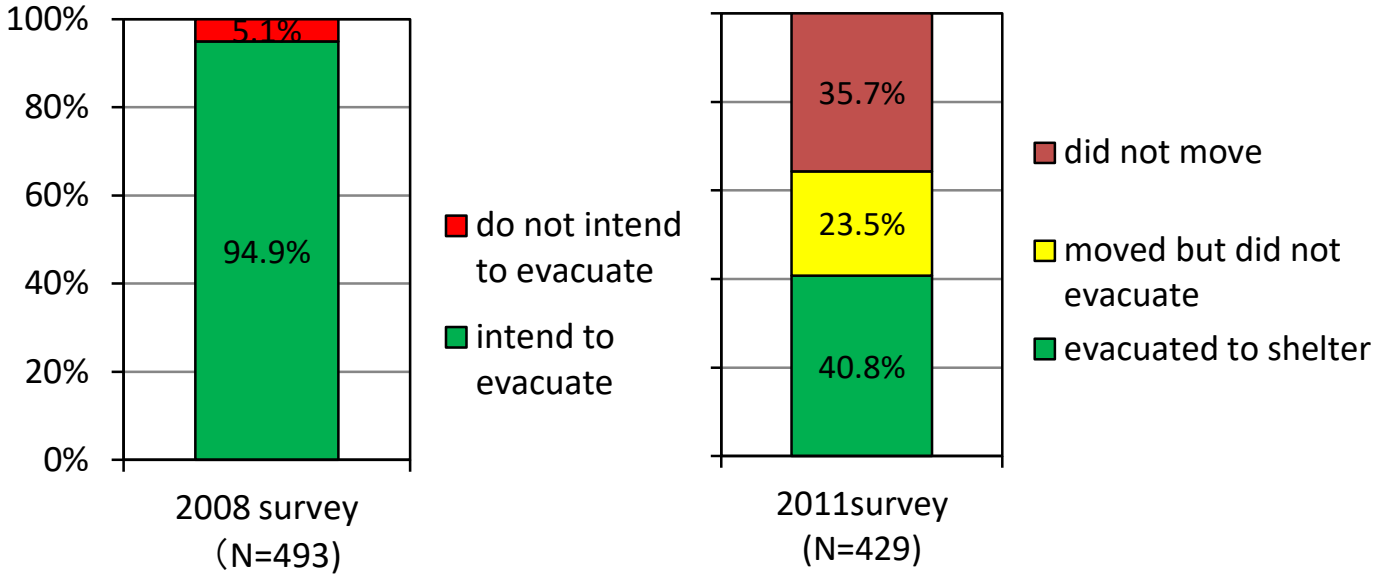
- **Risk perception and communication**
  - Gap between knowledge and actual actions
  - Tendency not to evacuate even after hearing the warning -> Normalcy bias
- **Inappropriate collective behavior * during disasters**
  - Is it true that people panic when a disaster strikes?
  - why rumors often occur during disasters？

* **Collective behavior**: Behavior that occurs when a large number of unorganized groups stimulate each other and uplift, including epidemics and social movements in normal times.

Gap between knowledge and actual actions

Questionnaire survey conducted before and after the Great East Japan Earthquake in 2011

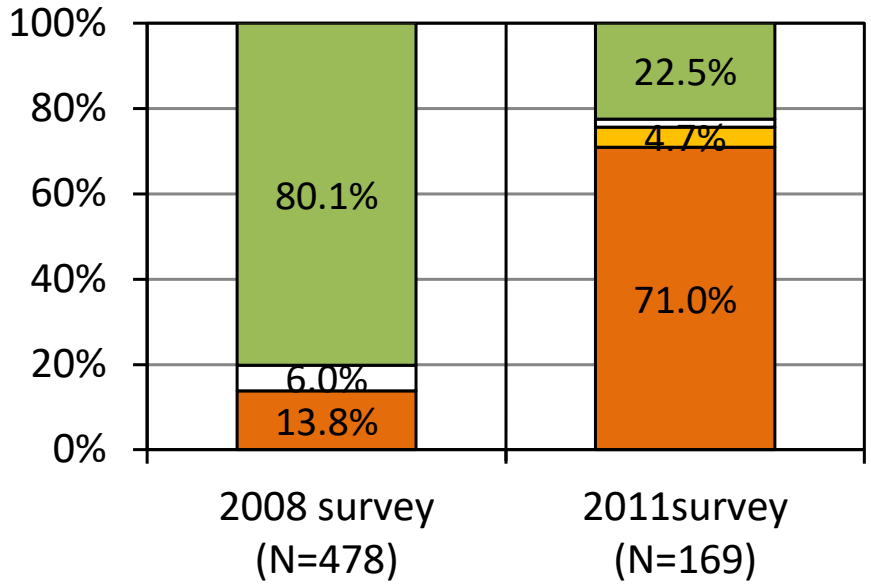
What they do



Intention to evacuate before the earthquake

Actual evacuation rate

How they evacuate



Means of transportation

Isagawa T. & Ohno, R. Residents‘ Behavior in a Potential Area for Tsunami Disaster after the Great East Japan Earthquake, IAPS22 Conference, Jun. 2012.

Tendency not to evacuate even after hearing the warning

⇒ Normalcy bias

Can we immediately judge that a sudden change in our environment is abnormal and act promptly to avoid danger?

Looking at past disaster cases, it can be seen that many people at the disaster site were aware of some sort of incident but could not determine that it was an abnormal emergency.

This is a characteristic of human behavior that is widely seen during disasters called "**Normalcy bias**".

The fire in a subway station in Daegu, Korea

To overcome obstacles to the execution of evacuation

After receiving a warning of danger, people make the following decisions before evacuating:

1) Confirmation of the authenticity of information
2) Expected seriousness of damage
3) Evaluation of feasibility and effectiveness of evacuation

Evacuation is executed only when all the above three steps are positively judged.

Is it true that people panic when a disaster strikes?

Panic has traditionally been cited as an antisocial behavior that ignores the safety of others for one's own safety, and therefore as a collective behavior that increases the damage during a disaster.

However, this extreme self-centered collective behavior rarely occurs in practice.

Recent studies of human behavior during disasters have repeatedly reported that people are more likely to evacuate in an orderly manner without panicking.

The problem is to be afraid of panic unnecessarily and hesitate to convey appropriate information.

Photo from Janis Krums's tweet

US Airways aircraft crash landed on the Hudson River on January 15, 2009

Why rumors often occur during disasters？

The cause of rumors in times of disaster:

- Inadequate information given to information needs
- Increased speculation based on psychological anxiety and worry
- Chain of actions due to confirmation of information
- Increased speed and scope of false information spread by SNS in recent years

To prevent collective behavior, it is essential to have reliable agencies provide accurate information promptly.

After the Great East Japan Earthquake, convenience store shelves in Tokyo that have become scarce due to excessive hoarding

Behavioral changes caused by the Covid-19 pandemic

- Two meaning of the term "behavior change"
  - Temporary behavior change is an emergency evacuation behavior to avoid risk under a pandemic.
  - Continuing behavior change begins with the Covid-19 pandemic and continues even after convergence.
- Two possible causes of "behavior change"
  - Due to social norms and regulations
  - Due to individual emotions and consciousness

Behavioral changes due to social norms and regulations

(as a measure to avoid human proximity and contact)

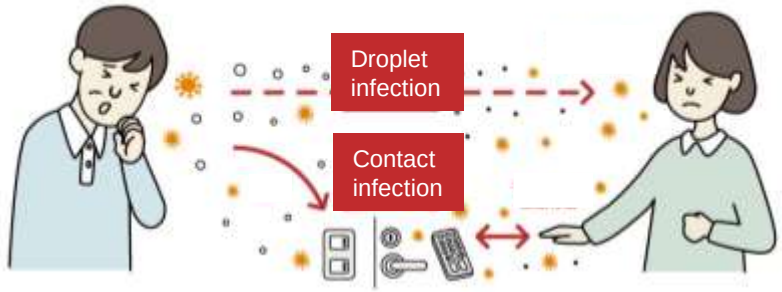
<Society>

Social norms / regulations

- Lockdown
- Remote work
- Staggered commuting
- Business hours restrictions
- Admission limit

Information on

- Outbreaks of Covid-19 in Japan and abroad
- Knowledge of infection routes and mechanisms



From Website of Osaka University Research Institute for Microbial Diseases

Changes in the distribution of the daytime population in Tokyo

<Society>

Information on

Outbreaks of Covid-19 in Japan and abroad

Knowledge of infection routes and mechanisms

Social norms / regulations

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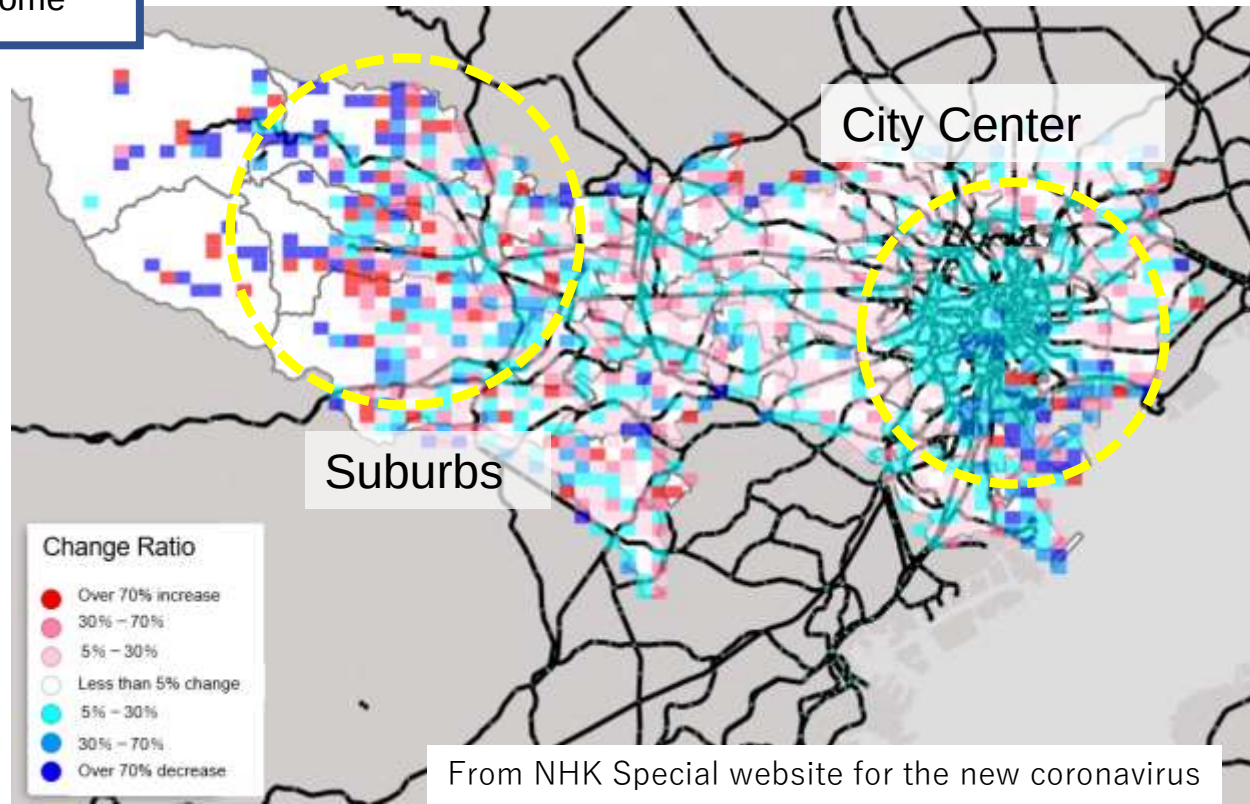
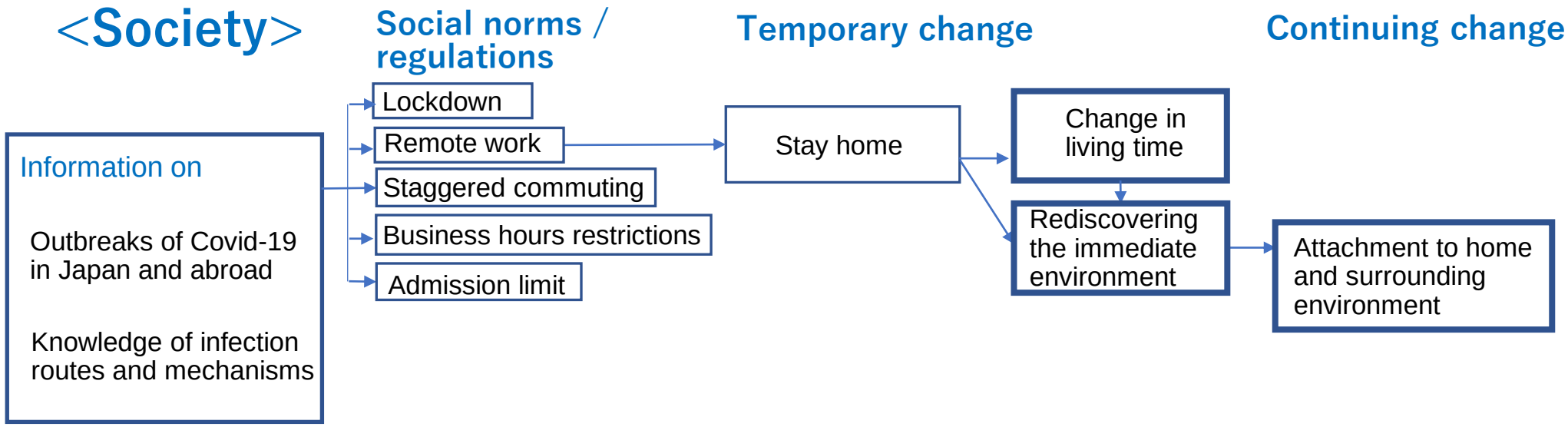
Temporary change

Stay home



From NHK Special website for the new coronavirus

Change in awareness of living environment due to stay home



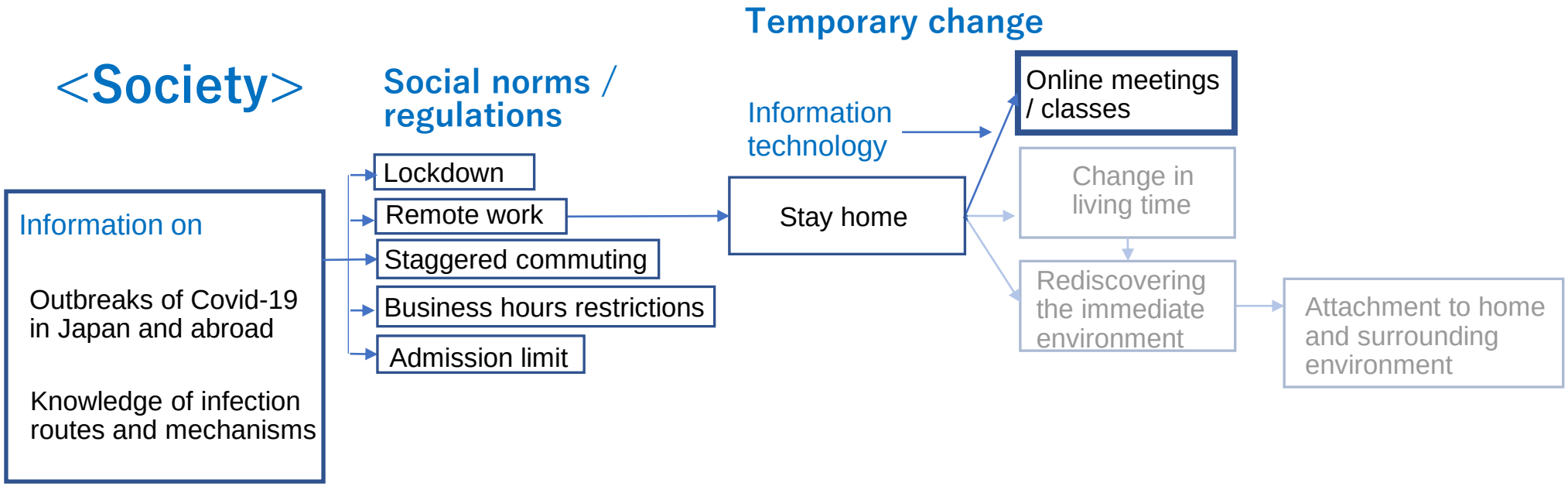
Rich nature

Local culture

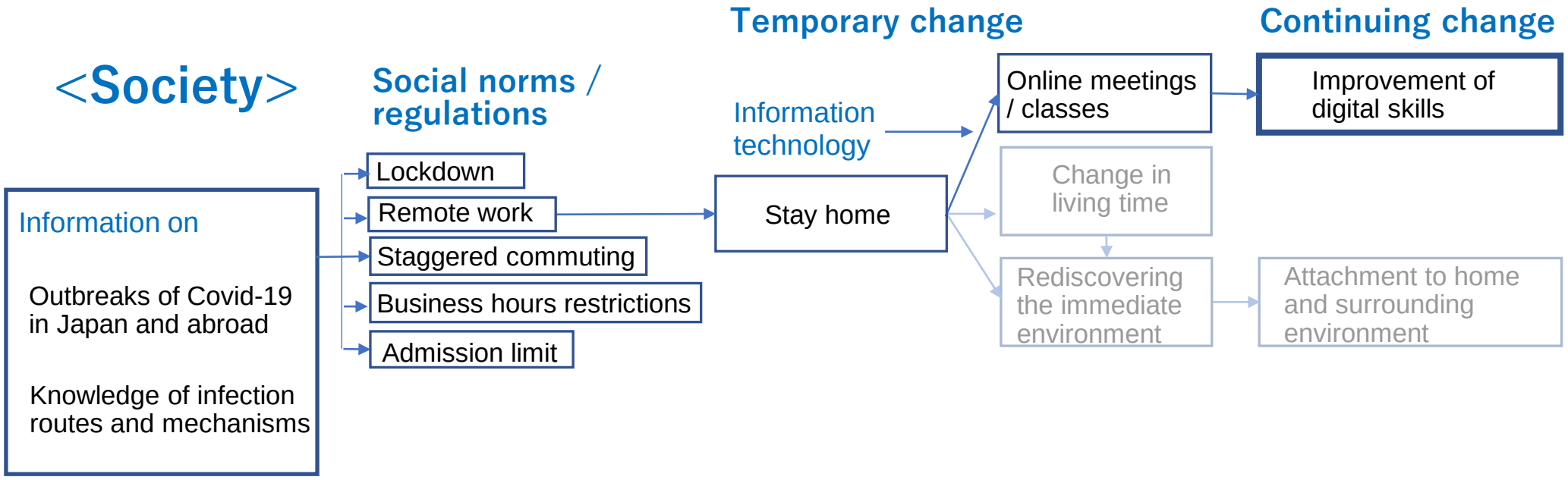
Small shop

Increased use of boardwalks

Utilization of information technology



Improvement of digital skills



Merits and demerits of online communication

Merits

- ○ Travel Time Savings
- ○ Efficient exchange of information and reference materials

Demerits

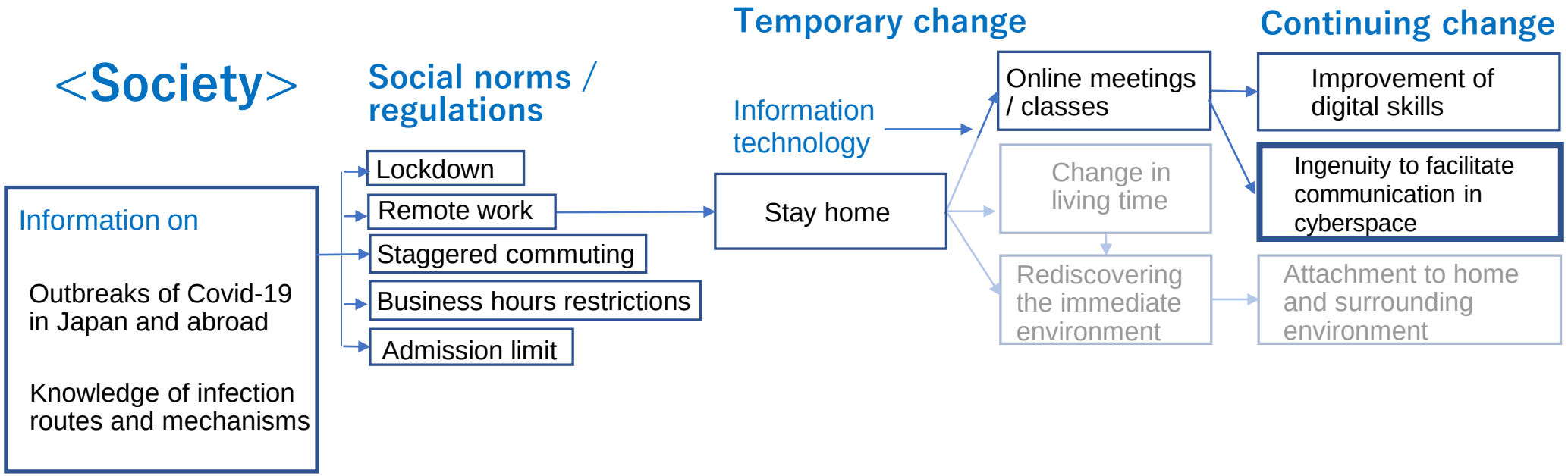
- Losing the opportunity to mentally prepare for the upcoming meeting or lecture
- Inability to convey "atmosphere" in a face-to-face space (Insufficient nonverbal communication)
- Difficulty in fostering trust and empathy among participants

In the actual room, there is margin space and time to leisurely come in and out and chat. Anthropologist Dumbar* points out that this chat is an important part of connecting people. This may be the reason why it is difficult to foster trust and empathy among participants in online meetings with members who have never met in person.

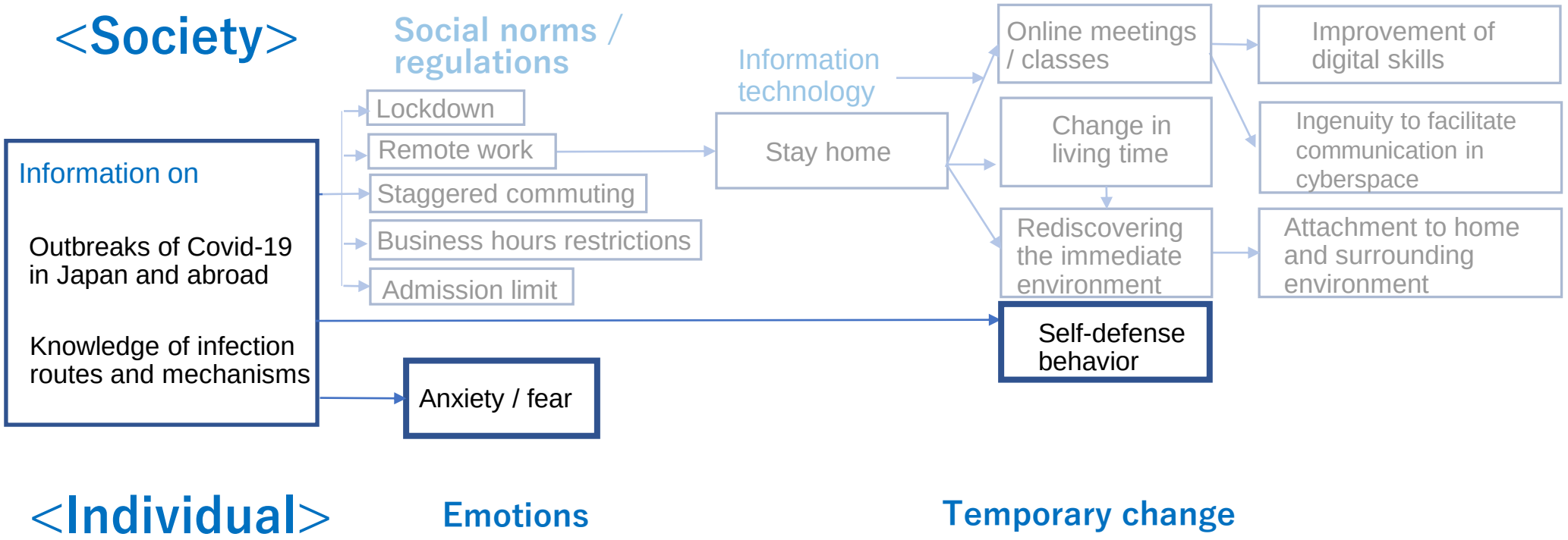
*Dunbar, R.: Grooming, Gossip, and the Evolution of Language, Harvard University Press,1998.

Ingenuity to facilitate communication in cyberspace

⇒The latent function of margins (The usefulness of the useless)

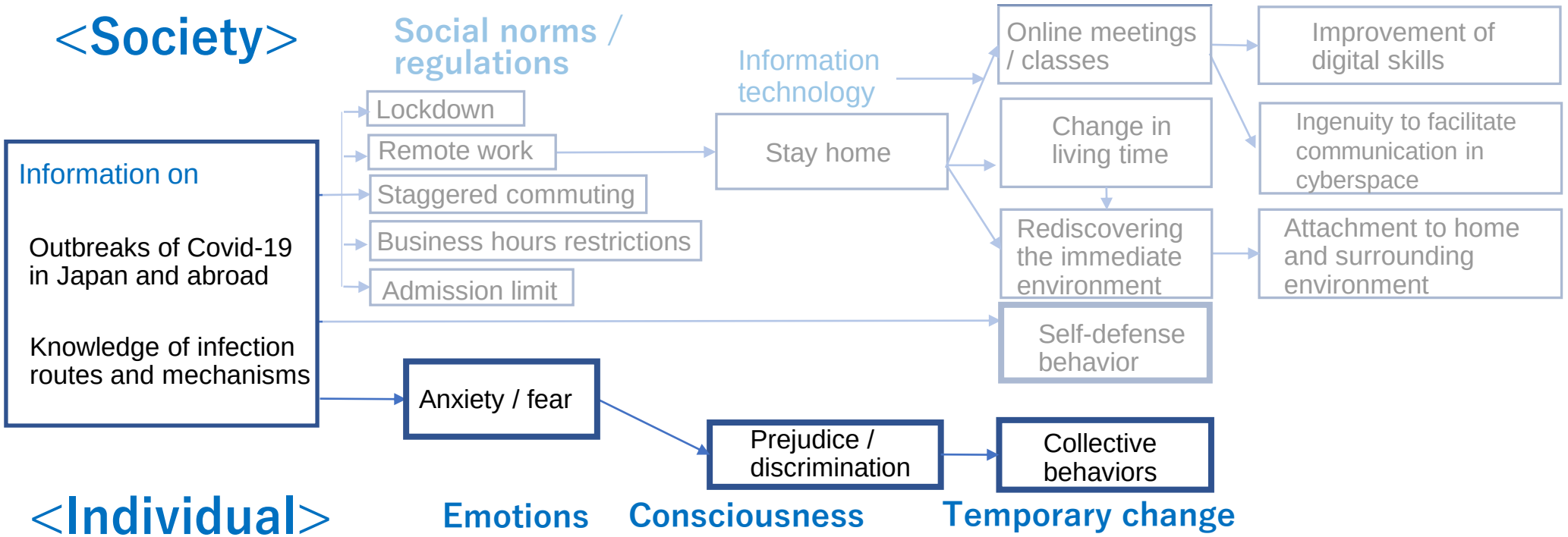


Behavior changes due to individual emotions and consciousness



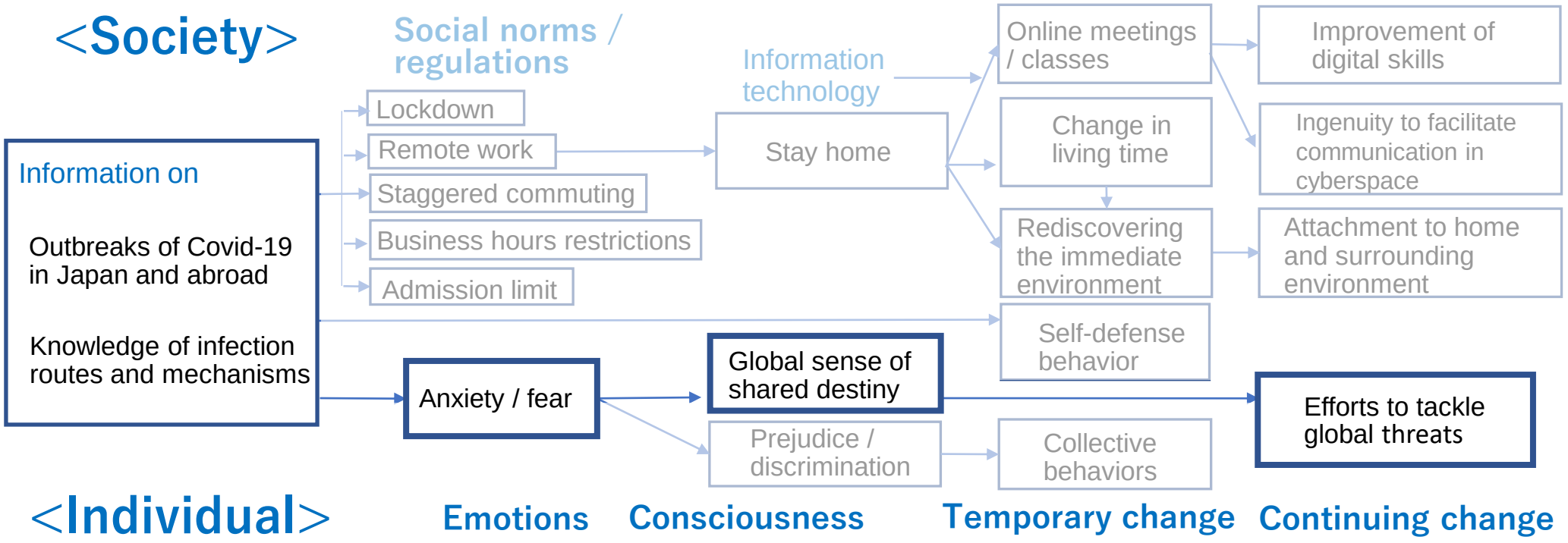
Negative emotional effects

Collective behaviors

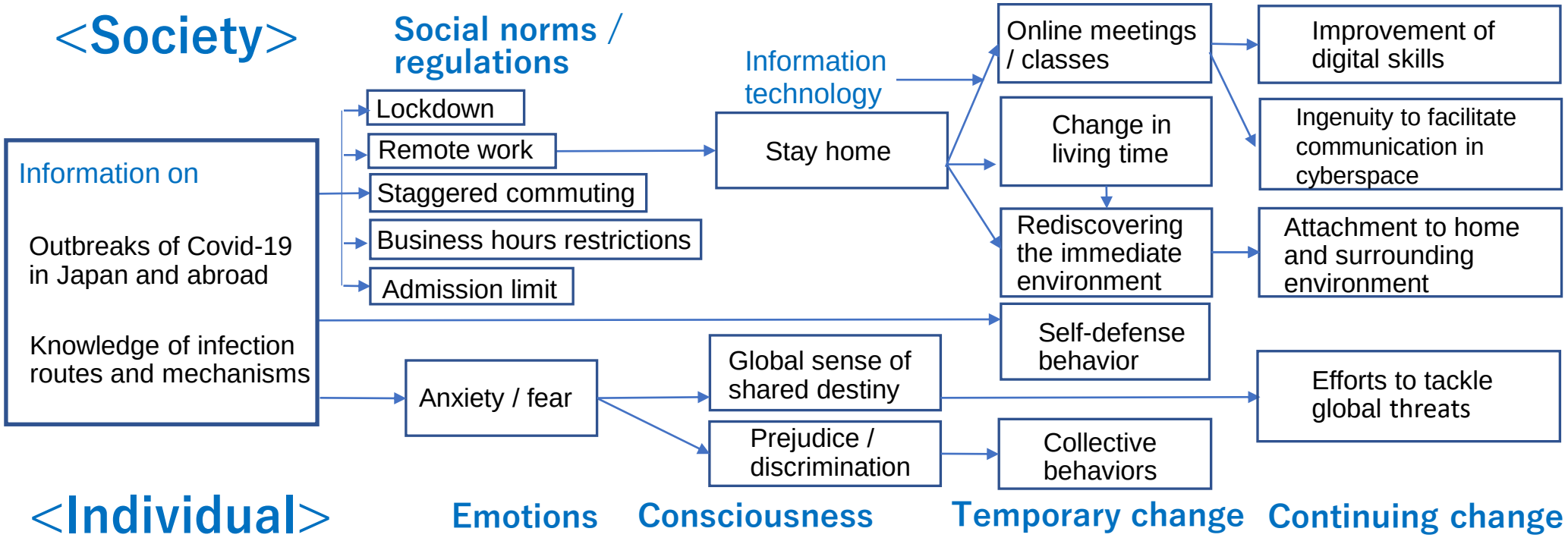


Positive emotional effects

Leading to awareness of global threats



Various behavioral changes caused by Covid-19 and their impact



”Think Globally, Act Locally” could be realized because of Covid-19!?

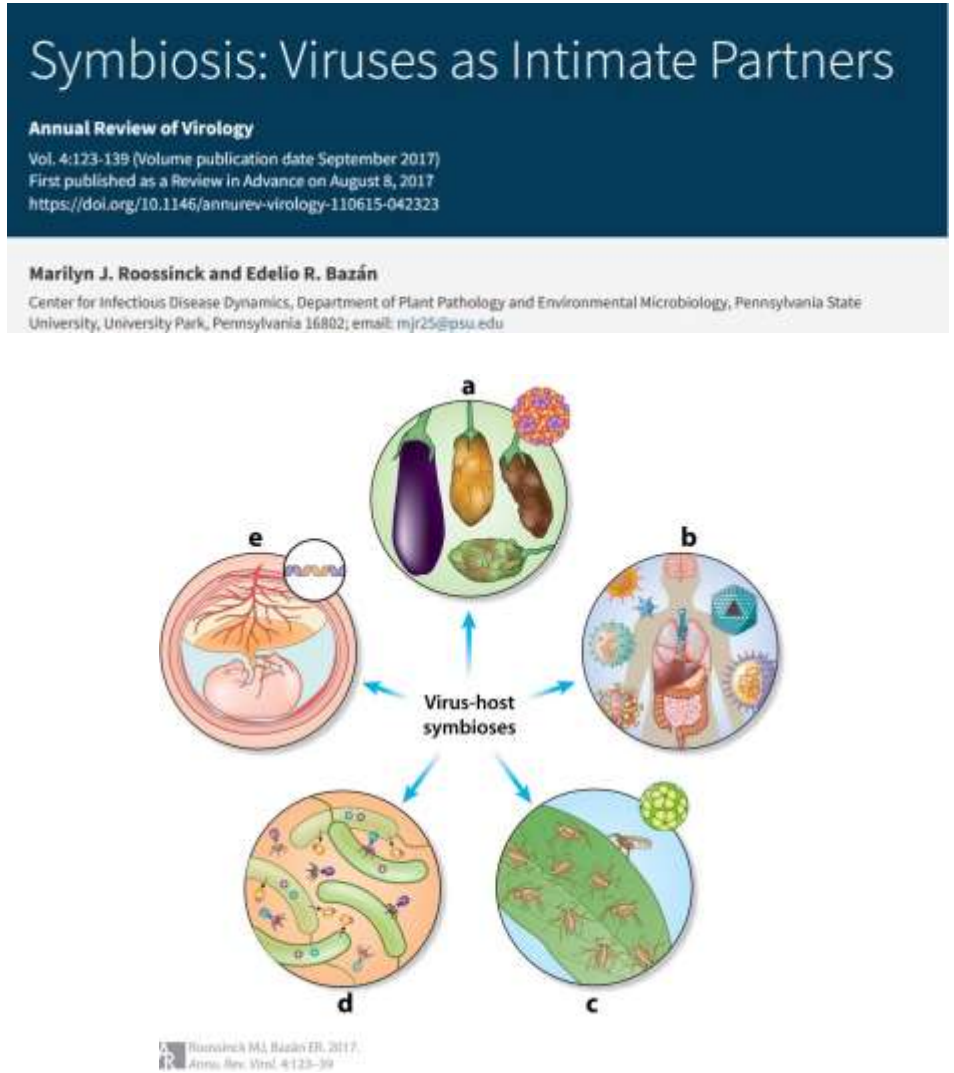
How can EBS contribute to preparing for future pandemics?

In the future, it will always be "with Corona", not "post-Corona"

The biological world contains a myriad of viruses, 99% of which are harmless. Viruses have been involved in the evolution of organisms by passing genes to their hosts.

In this century and the next, the new coronavirus will live on. We have no choice but to continue living with coronas.

Just as natural disasters such as major earthquakes always have a certain probability of occurring, epidemics inevitably occur.

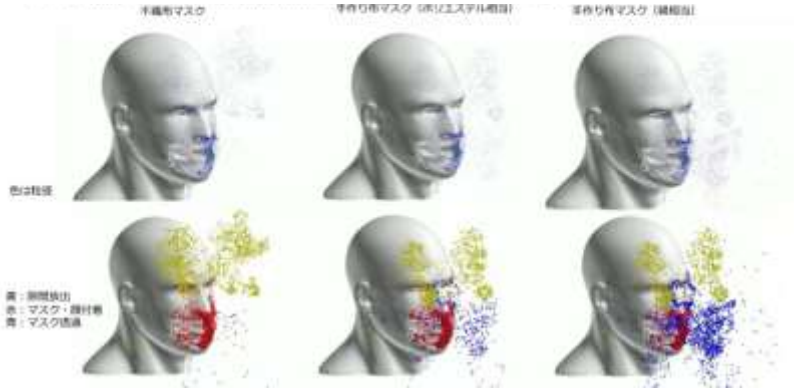


The spectrum of virus-host symbioses.

Lack of information at architectural scale

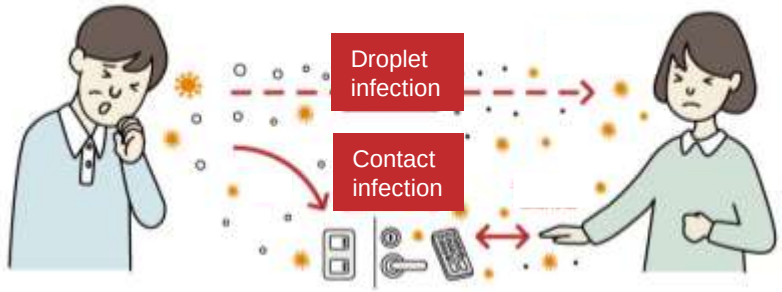
Micro-scale phenomena around the human body

Comparison of droplet suppression effect of different mask materials



RIKEN Center for Computational Science

Route and Mechanism of Infection



From Website of Osaka University Research Institute for Microbial Diseases

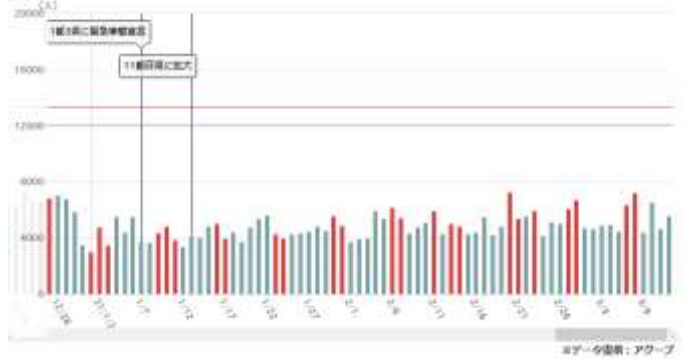
architectural scale

?

Macro-scale statistics on human behavior

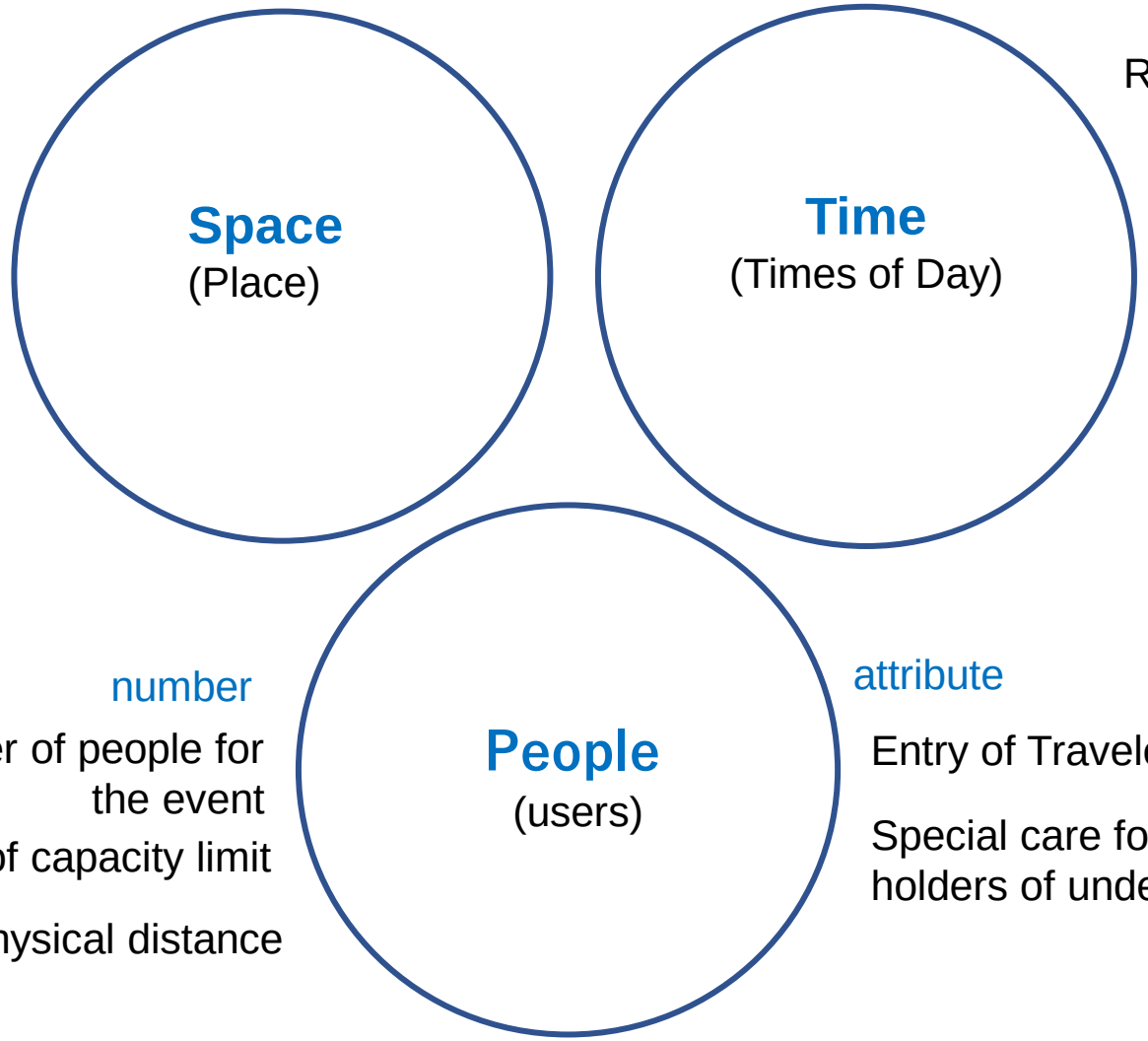
Changes in the distribution of the daytime population in Tokyo due to the Covid-19

Statistical data on the status of urban crowds



NHK 特設サイト
https://www3.nhk.or.jp/news/special/coronavirus/

Infection control through various **restrictions** to date



Avoid places such as Karaoke, tavern, host club

Disinfection of areas touched by multiple people

Regular ventilation

Install partition

Refrain from going to town at night

Restaurant business hours

Use of stores during less crowded hours

Staggered commuting

number

Maximum number of people for the event

Percentage of capacity limit

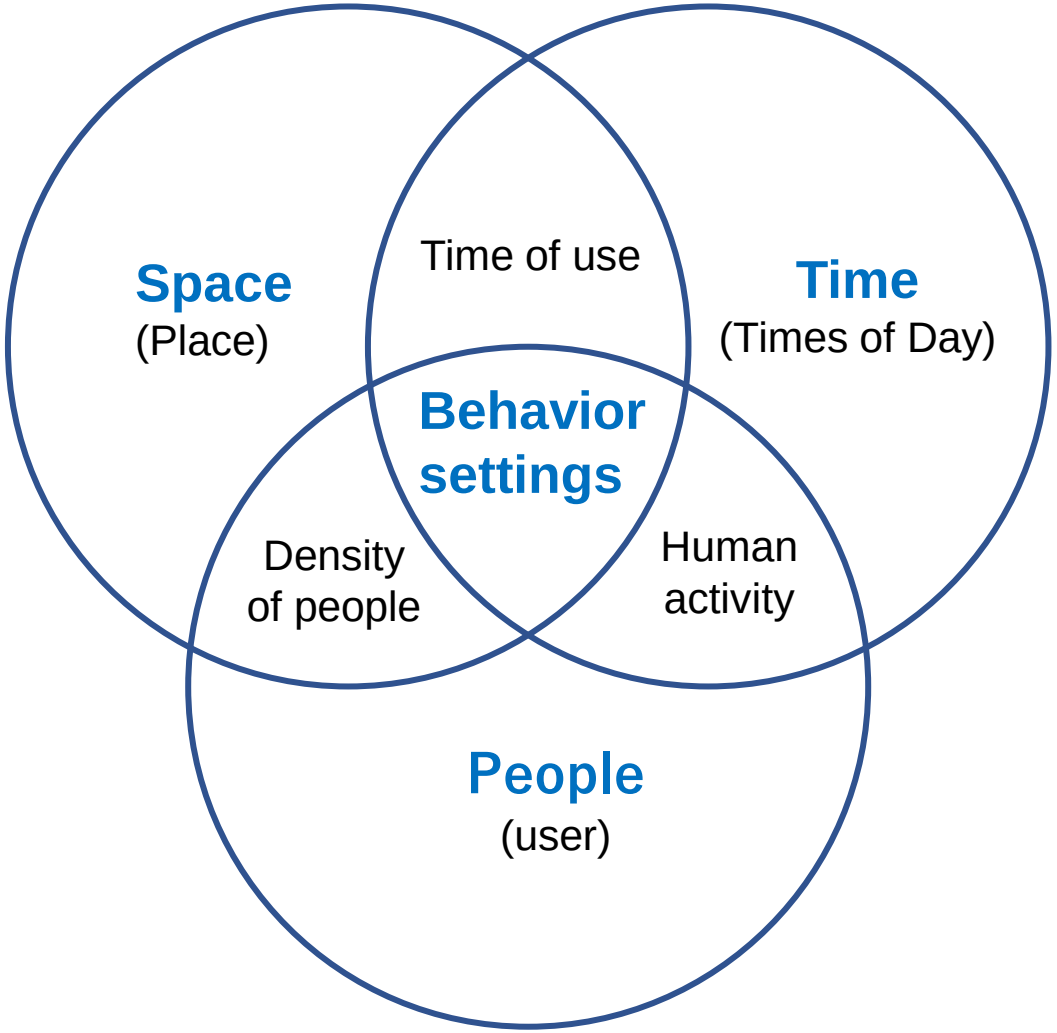
Interpersonal physical distance

attribute

Entry of Travelers from overseas

Special care for the elderly/ holders of underlying diseases

Proposed infection control using the concept of **Behavioral Settings**



Behavioral Setting is the unit of analysis for clearly grasping what kind of standing pattern of behavior is repeated in what kind of place, by whom, in what time zone.

Considering architecture as an intertwined set of many behavioral settings, it would be possible to identify hotspots of infection risk in the architectural space at the behavioral setting level.

Steps to identify Behavioral Settings at high risk of infection

1) Identify the behavioral circuits of the various users of the building

2) Identify behavior settings along the circuits

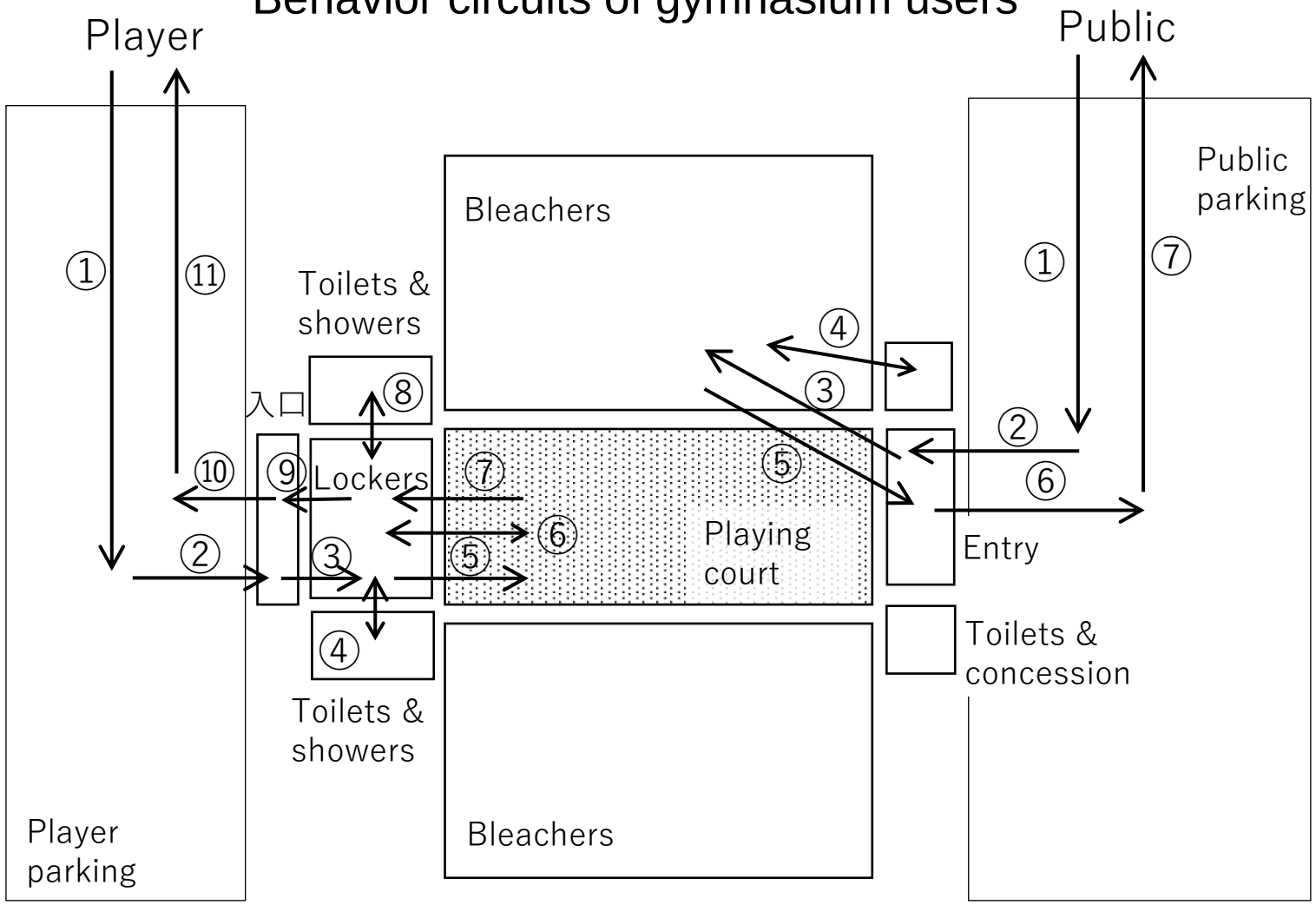
3) Identify standing pattern of behavior and examine the risk of infection at each behavior setting

Facility managers are to be aware of the specifics of

- When
- Where
- Whose behavior

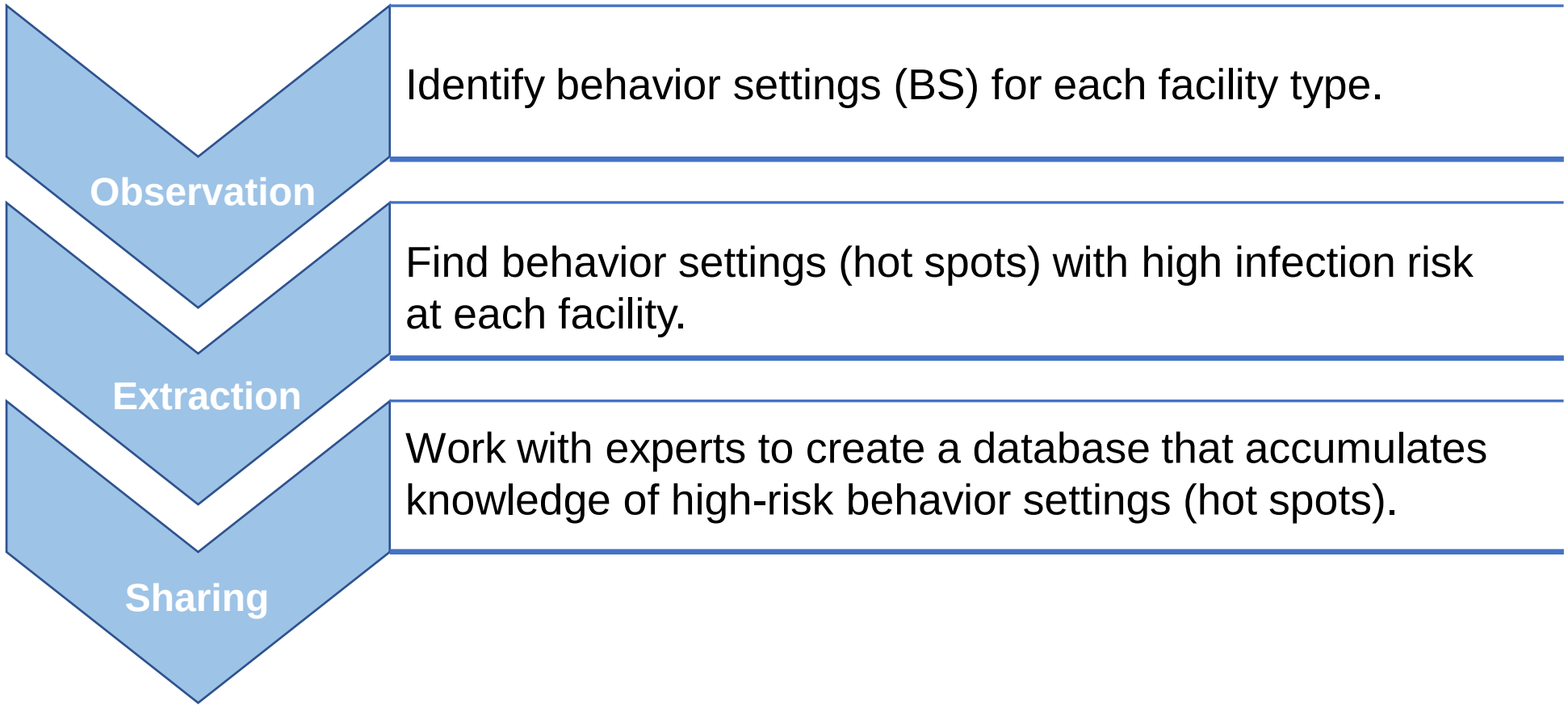
creates infection risks.

Behavior circuits of gymnasium users



From E.T. White, Concept Sourcebook (Tucson, Arizona,: Architectural Media, 1975) cited by Thiel[7]

Effective infection control measures by accumulated experiences



Effective infection control

Review of major points

- Experiences of natural and technological disasters
- Determinants of the magnitude of disasters
- Importance of soft measures for disaster mitigation
- Environment behavior studies in response to disasters
- Behavioral changes caused by the Covid-19 pandemic
- Infection control considering behavioral settings in architectural spaces