A GROUNDED THEORY APPROACH TO UNDERSTANDING BICYCLISTS' INTERACTIONS ON BICYCLE LANES:

PROOF OF CONCEPT FOR A NEW OBSERVATIONAL METHOD

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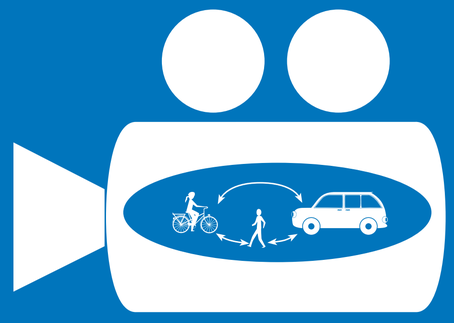

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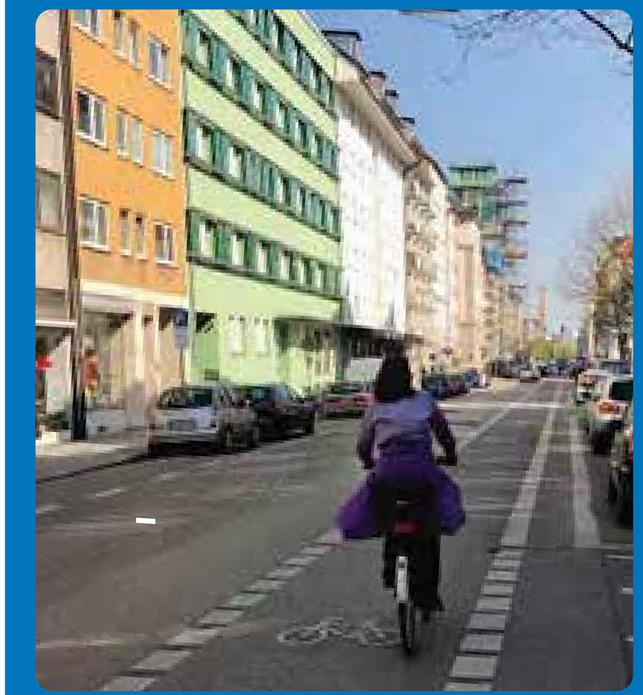
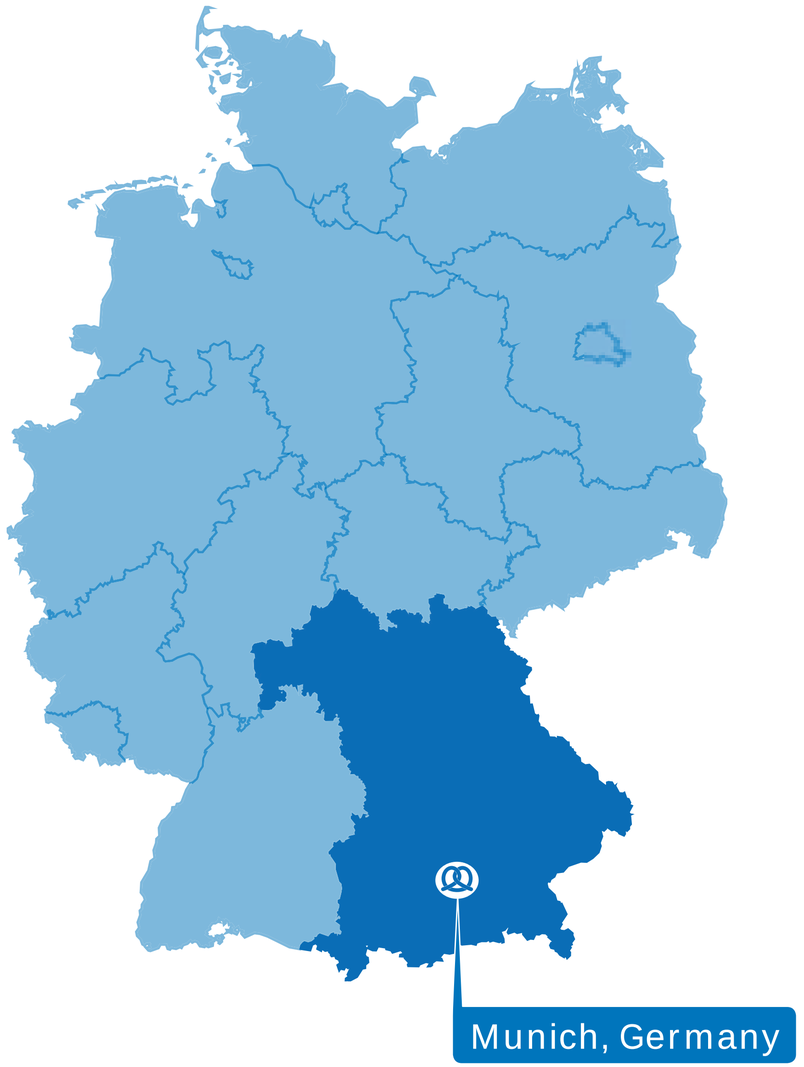
BEST TYPE OF BIKE LANE?

On the Street



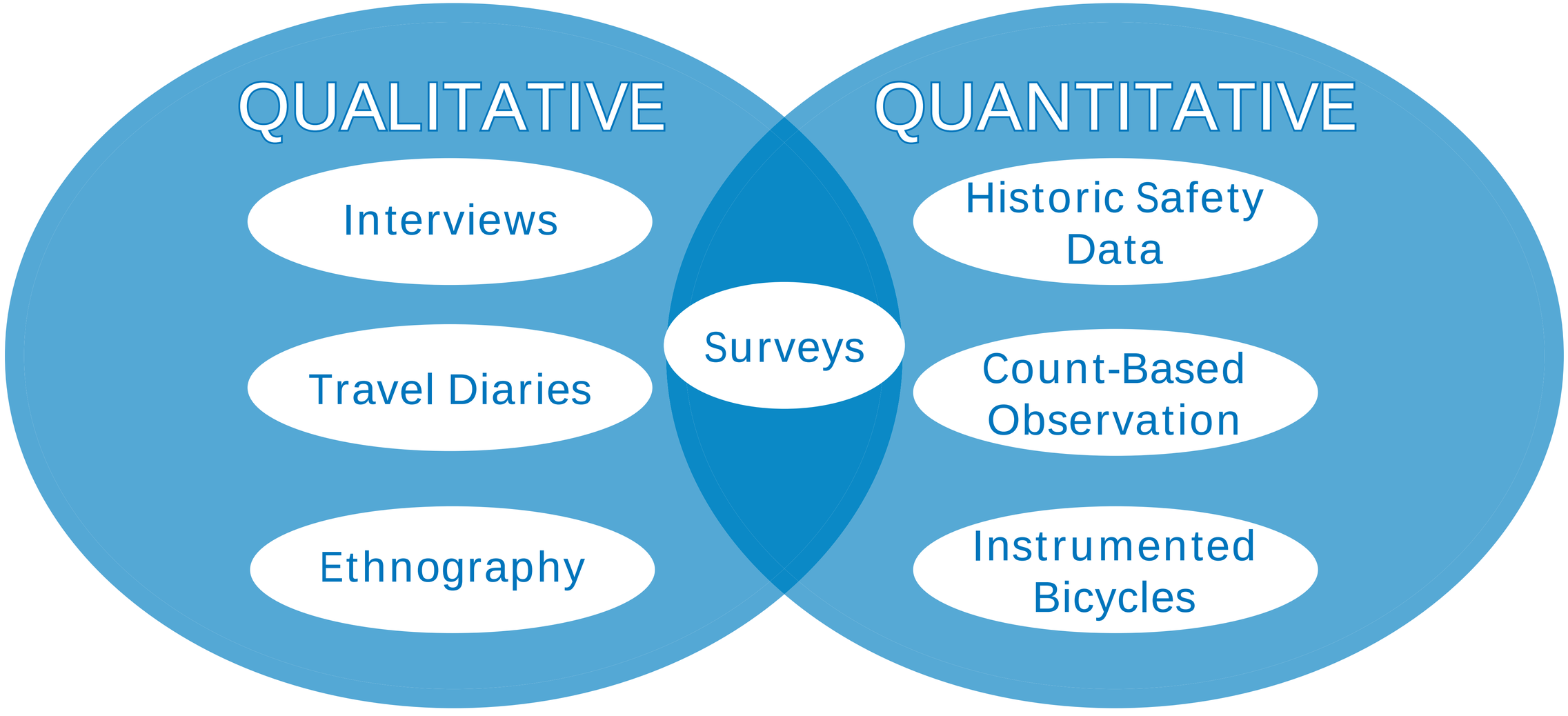


On the Sidewalk

RESEARCH QUESTION

What types of
interactions and **conflicts**
are bicyclists involved in while
using streets with
different types of bicycle lanes?

METHODS TYPICALLY USED



A QUALITATIVE APPROACH

Near-Miss Project

(Aldred and Crosweller 2015; Near Miss Project 2015)

Method:

- Travel Diary and Survey

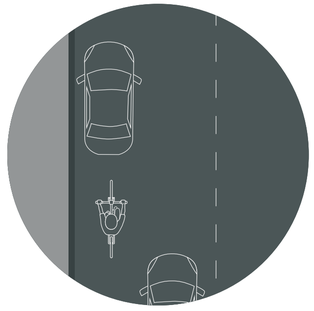
Outcome:

- Typology of Near-Miss Incidents

Limitations:

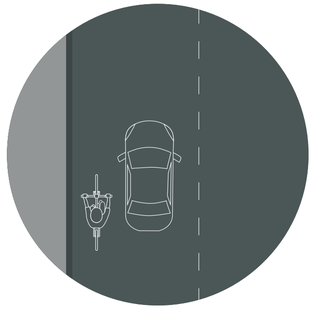
- Relies on Reported Incidents
- Only the Bicyclist's Perspective
- No Evidence of Incidents

CYCLIST'S WAY BLOCKED



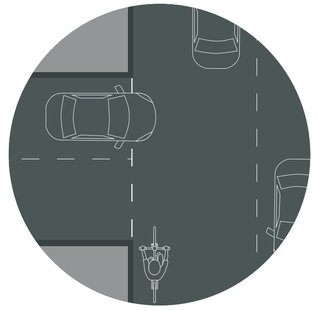
When a cyclist's way is blocked by an obstruction e.g - a parked car.

PROBLEMATIC PASS



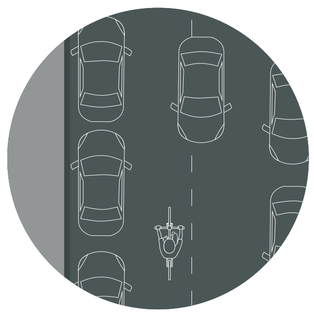
A close pass is when a motorist gives too little space when over-taking a cyclist.

VEHICLE PULLING OUT



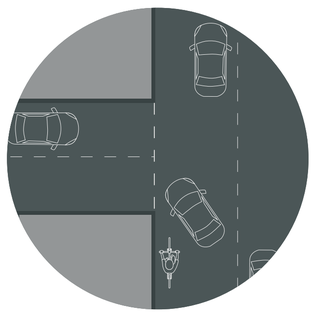
When a driver pulls out or in across a cyclist's path

A CYCLIST IS DRIVEN AT



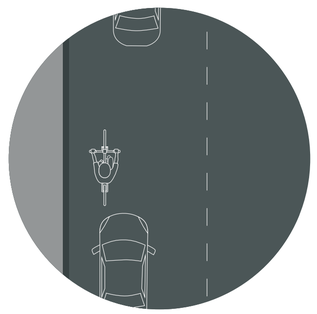
Occurs on narrow(ed) roads when a driver continues straight on forc-ing the cyclist to pull in or swerve into a pavement.

NEAR LEFT / RIGHT HOOK



When a motorist (or cyclist) turns left / right across the cyclist's path.

TAILGATING



When a driver follows a cyclist too closely without passing.

A QUANTITATIVE APPROACH

Before-and-After Safety Study

(Jensen 2007)

Method:

- Video-Based Observation

Outcome:

- **Safety Effect Based on Change in** Crash and Injury Frequencies

TABLE 3 Safety Effects of Bicycle Tracks

		Observed BEFORE	Expected AFTER	Observed AFTER	Safety effect (percent)	
					Best estimate	95% CI [a]
Crashes	All	2,987	2,663	2,9:1	+10 [b]	-2 ; +23 [b]
	Injury	1,313	784	875	+12	+2 ; +23
	Property damage only	1,674	1,879	2,036	+6 [b]	-8 ; +22 [b]
Injuries	All	1,476	857	937	+9	+0 ; +19
	Fatal	25	19	22	+10	-1 ; +23
	Severe	757	606	665		
	Minor	694	231	250	+8 [b]	-17 ; +40 [b]
Intersections	All crashes	2,010	1,840	2,171	+18 [b]	+6 ; +32 [b]
	All injuries	938	541	636	+18	+6 ; +31
Links	All crashes	977	823	740	-10 [b]	-26 ; +10 [b]
	All injuries	538	316	301	-4	-17 ; +12
Pedestrians, all injuries	Total	469	271	315	+19	+2 ; +38
	At intersections	267	154	197	+30	+7 ; +57
	On links	202	117	118	+7	-16 ; +35
Bicyclists and moped riders, all injuries	Total	574	369	406	+10	-4 ; +26
	At intersections	353	230	285	+24	+5 ; +46
	On links	221	139	121	-13	-32 ; +10
Motorists, all injuries	Total	433	217	216	+4 [b]	-24 ; +43 [b]
	At intersections	318	157	154	-3 [b]	-32 ; +39 [b]
	On links	115	60	62	-1 [b]	-28 ; +37 [b]

[a] 95% confidence interval, [b] inhomogeneous i.e. results of random effects model.

Limitations:

- Focuses Only on Crashes and Injuries
- No New Insights Into Typologies of Incidents




"...it is not possible to pre-program the interaction between public life and space in detailed, but targeted studies can provide a basic understanding of what works and **what does not, and thus suggest qualified solutions."** (Gehl, 2013)









A NEW MIXED-METHOD APPROACH

Avoiding Reliance on Reported Behavior:

"...it is not unusual for persons to say they are doing one thing but in reality they are doing something else." (Corbin & Strauss 2015)

Focusing on Observed Behavior:

"...direct observation provides much more accurate results about behavior than do reports of behavior." (Bernard 2018)

Applying Grounded Theory:

Data is gathered using both inductive and deductive logic, with an openness to document and analyze both expected and unexpected interactions.

GROUNDED THEORY

Core Concept:

"the discovery of theory from data" (Glaser and Strauss 1967)

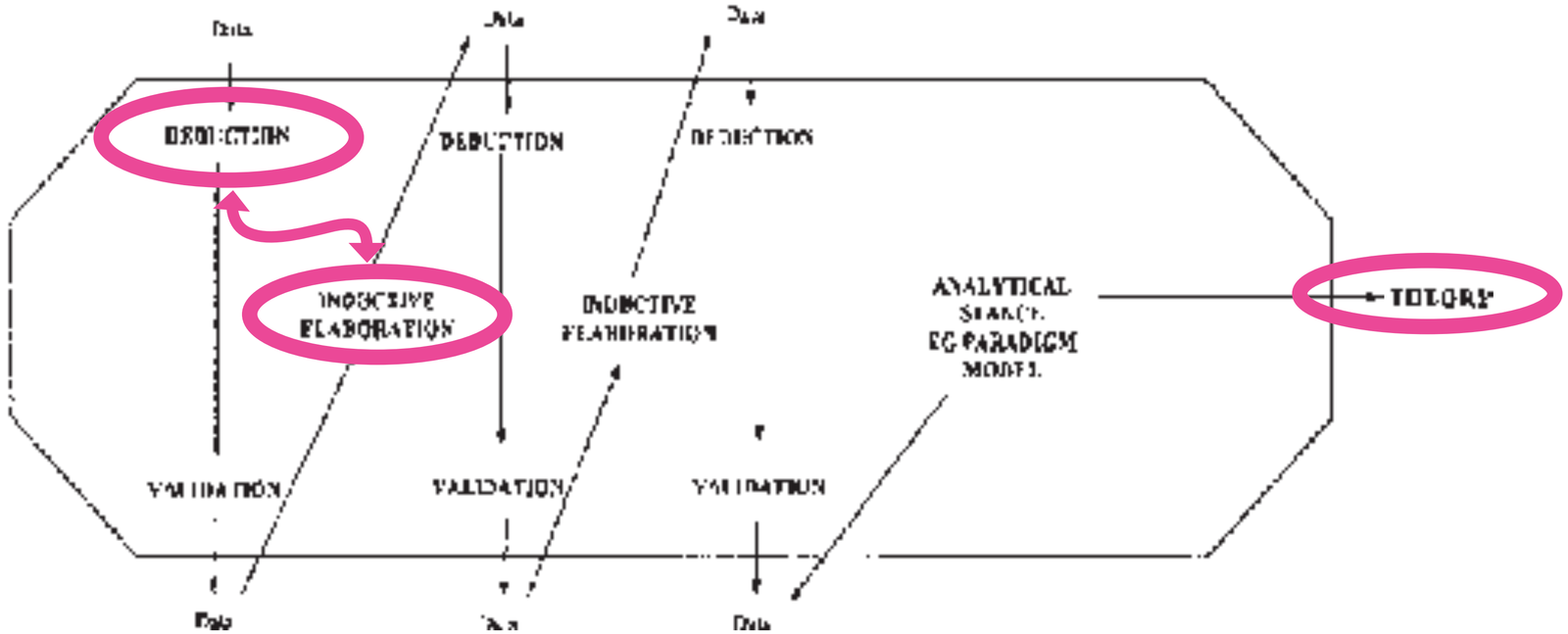


Fig. 3. Strauss and Corbin (1998) induction, deduction and validation in grounded theory analysis.

Source: Heath and Cowley 2004

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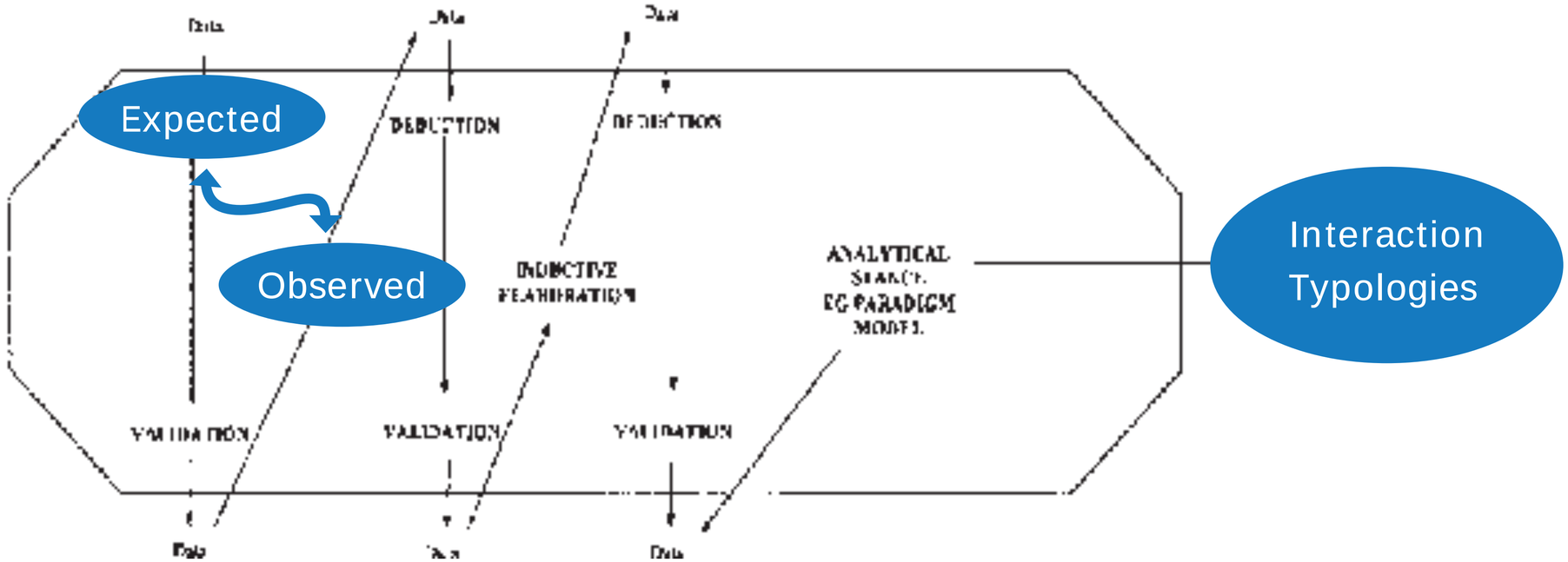


Fig. 3. Strauss and Corbin (1998) induction, deduction and validation in grounded theory analysis.

Source: Heath and Cowley 2004

GROUNDED THEORY CODING

Classic
Discover Theory

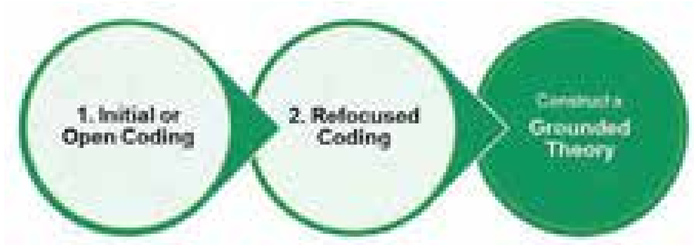
Figure 1. The Coding Procedure of Classic GT (Holton, 2010)

Straussian
Create Theory

Figure 2. The Coding Procedure of Straussian GT (Strauss & Corbin, 1990)

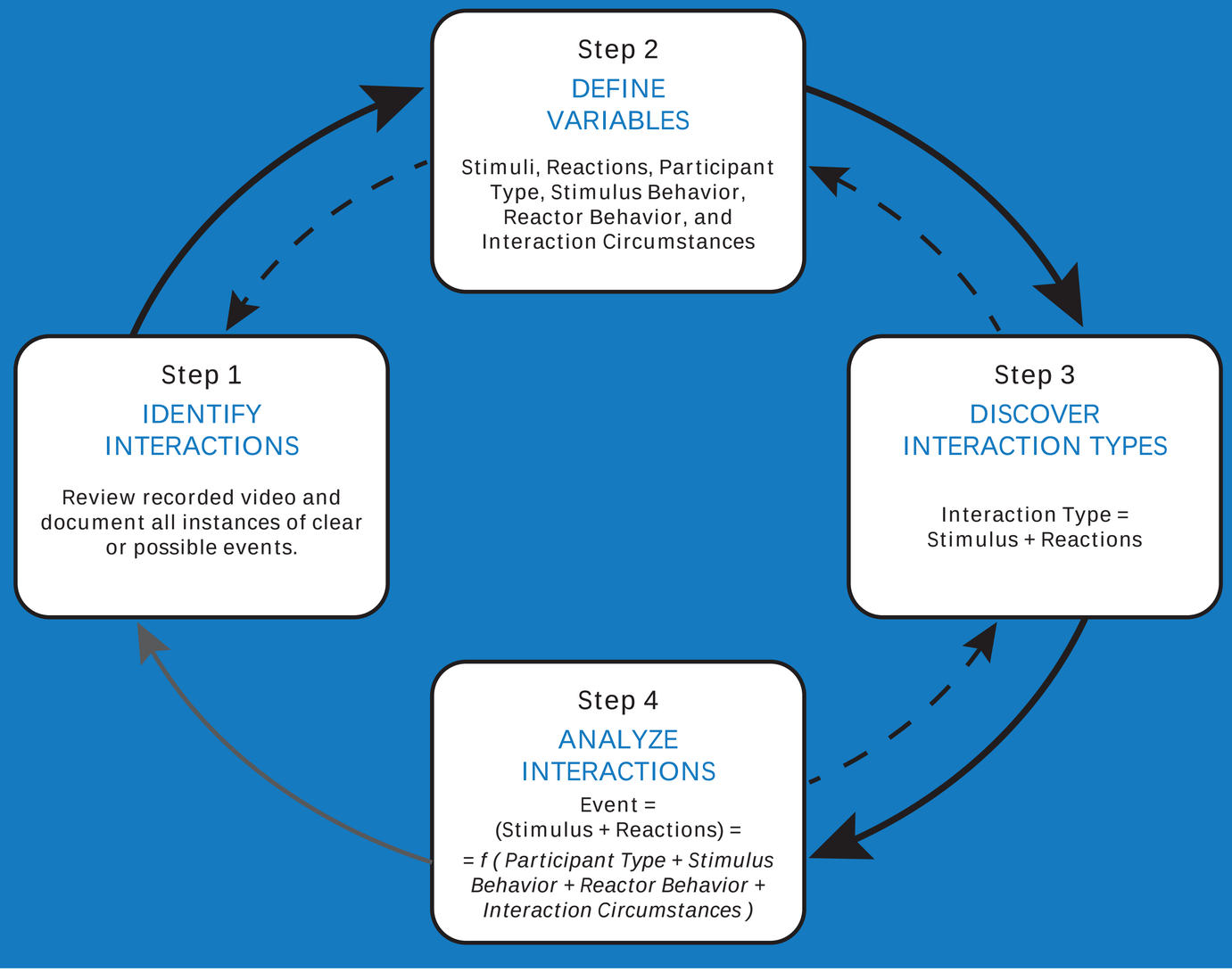
Constuctivist
Construct Theory

Figure 3. The Coding Procedure of Constructivist GT (Charmaz, 2008)



Source: Kenny & Fourie 2015

OBSERVATIONAL CODING PROCESS



FILM STUDY SITE

Observe Interactions

Define Variables

Discover Interaction Type

Analyze Interactions

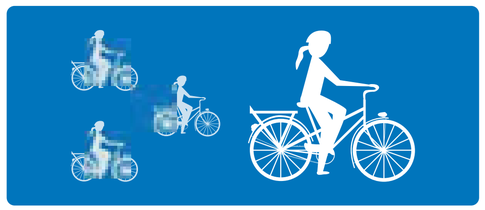
DEFINING AN INTERACTION EVENT

Observe Interactions

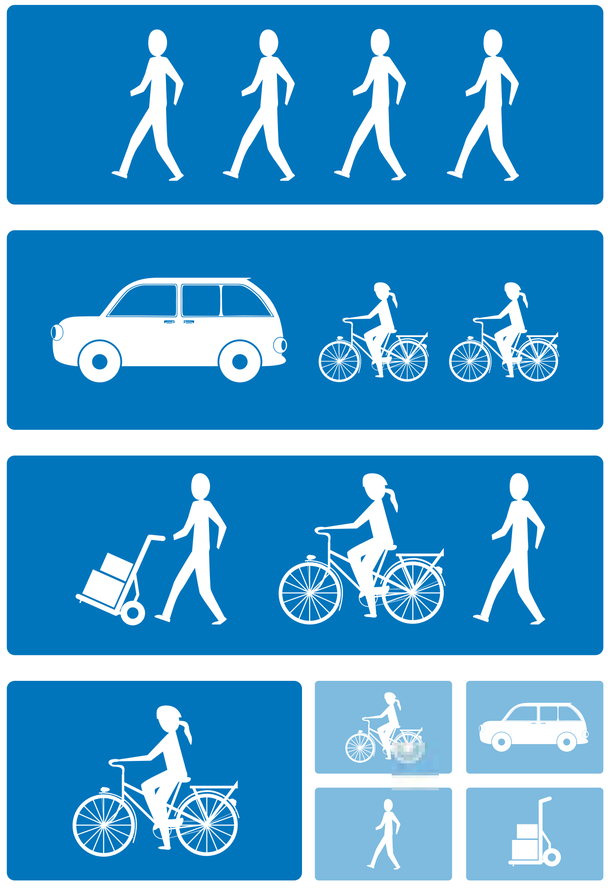
Define Variables

Discover Interaction Type

Analyze Interactions



At Least One Bicyclist Involved



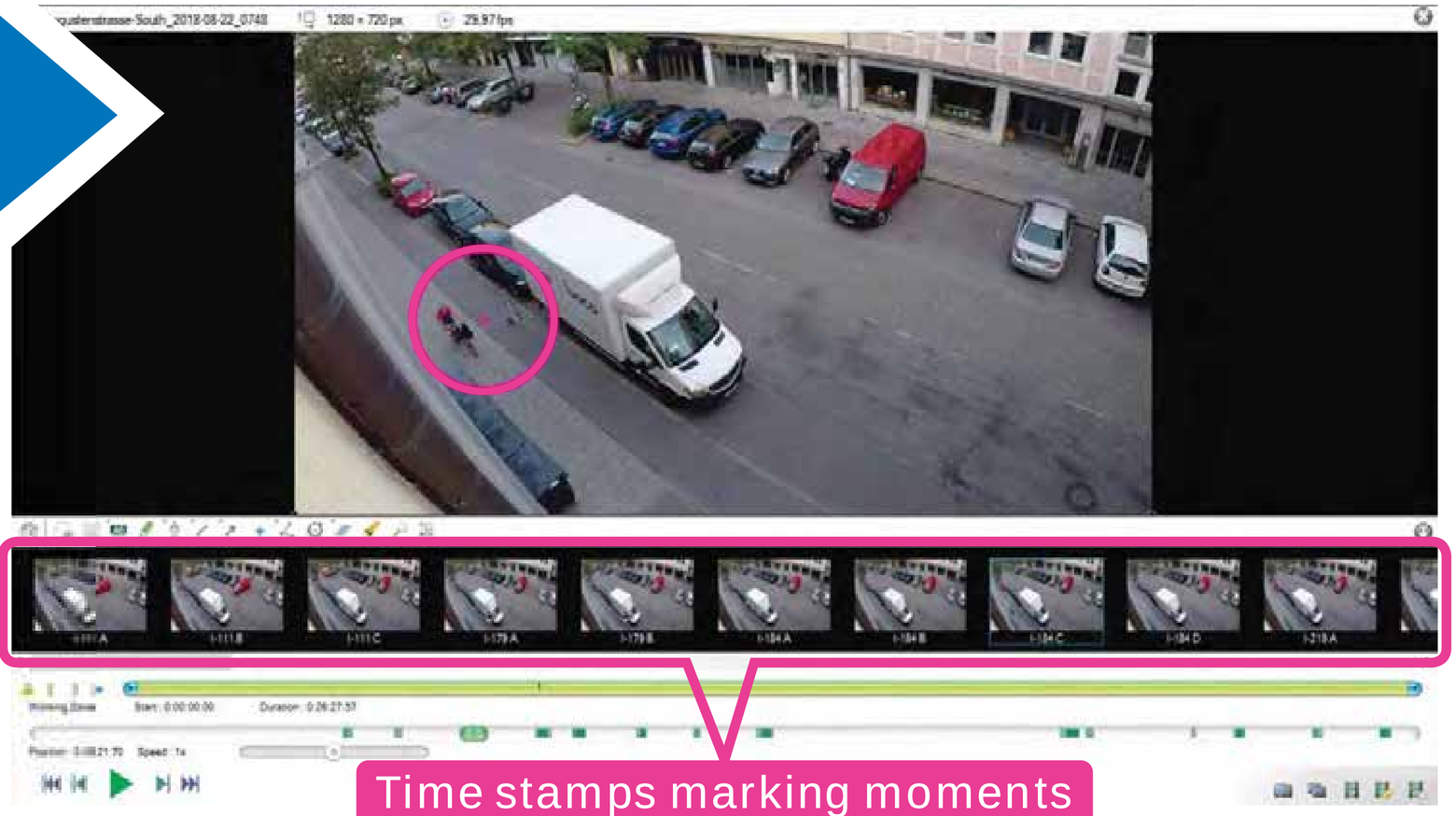
LABEL INTERACTIONS EVENTS ON FILM

Observe Interactions

Define Variables

Discover Interaction Type

Analyze Interactions



Time stamps marking moments of observed interaction,
including potential interactions

Software: Kinovea

GUIDING QUESTIONS

Observe Interactions

Define Variables

Discover Interaction Type

Analyze Interactions

GUIDING QUESTIONS

Observe Interactions

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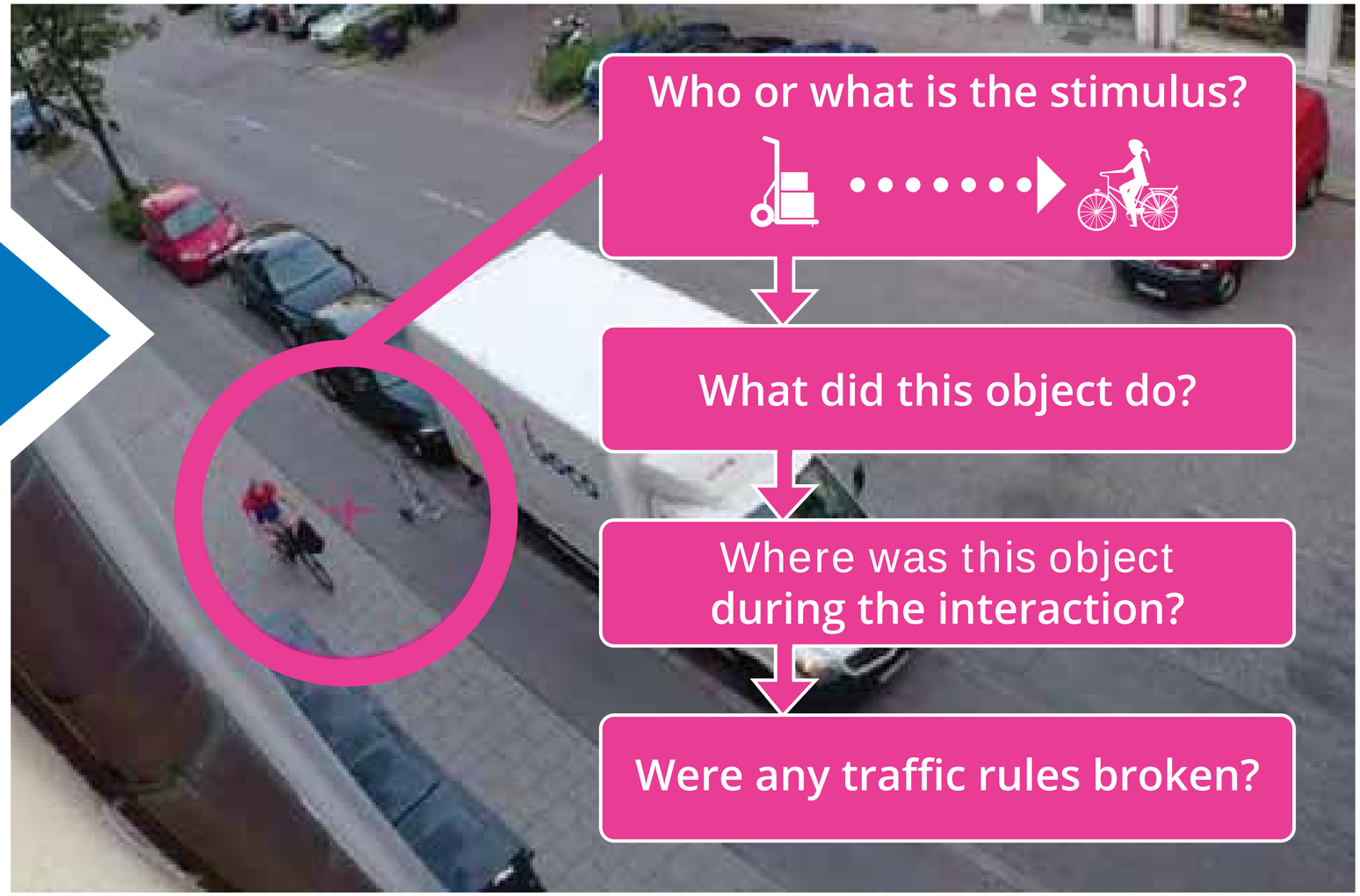

GUIDING QUESTIONS

Observe Interactions

Define Variables

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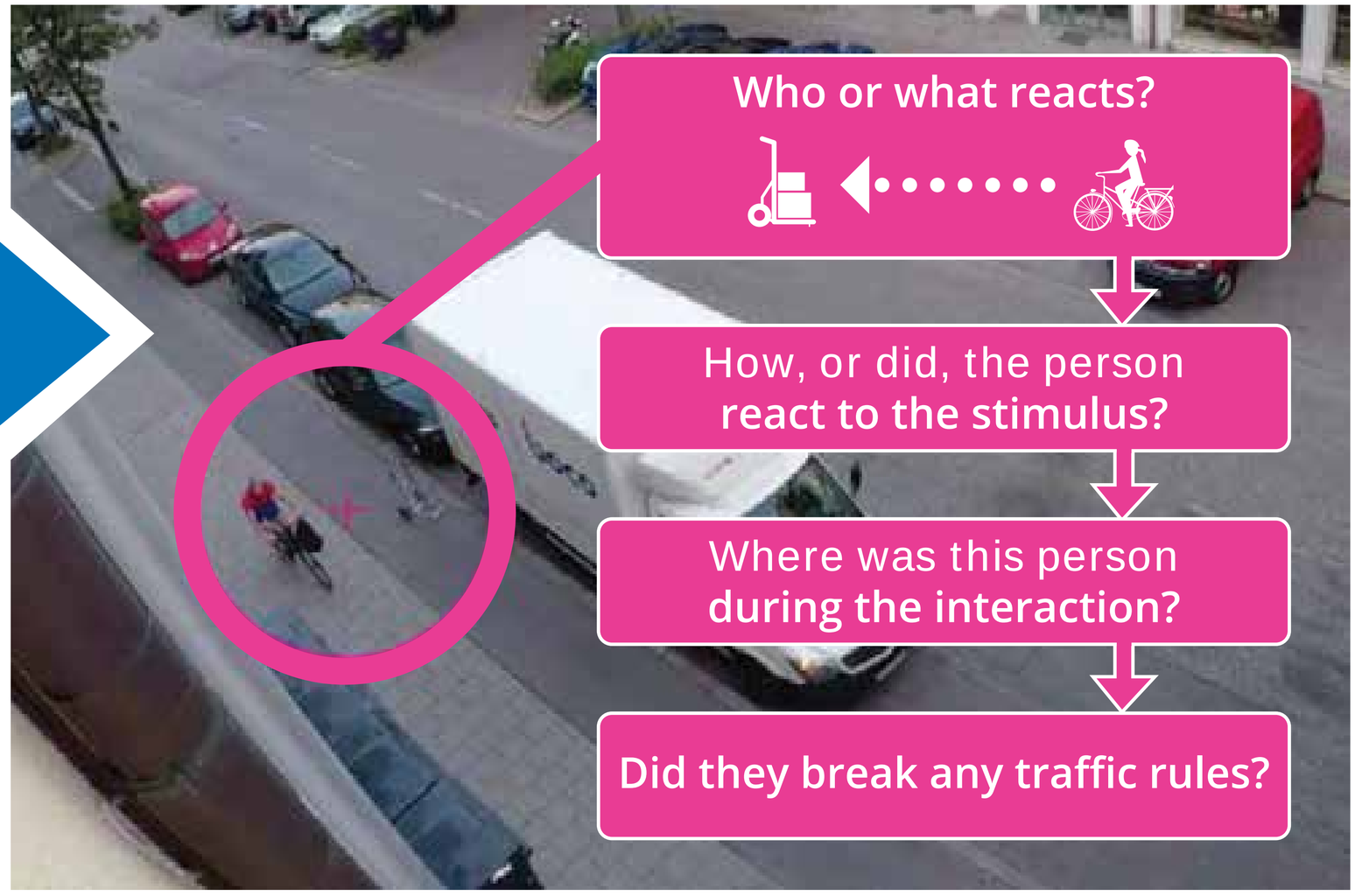


GUIDING QUESTIONS

Observe Interactions

Define Variables

Discover Interaction Type

Analyze Interactions

Who or what stimulated the occurrence of the interaction?

What was the primary action of the stimulus?

Who was impacted by the stimulus?

How did the impacted person(s) react to the stimulus?

How did the stimulus respond to the person(s) reacting?

What actions do participants engage in?

Were any stationary objects involved?

Where were participants on the street segment?

Did any participant violate a traffic rule?

When did the interaction occur?

VARIABLE CATEGORIES

Observe Interactions

Define Variables

Discover Interaction Type

Analyze Interactions

Stimulus	The action of person/object who is stimulating the interaction.
Reaction	The reaction (movement, speed, glancing) of the person impacted by the stimulus.
Participant(s) Type(s)	Participants' characteristics and their frequency of involvement in interactions.
Stimulus' Behavior	Stimulus' lane use and their responsive and rule-breaking behavior during interaction.
Reactor's Behavior	Reactor's lane use and rule-breaking behavior during interaction.
Interaction Circumstances	Temporal and locational factors as well as the number of participants involved.

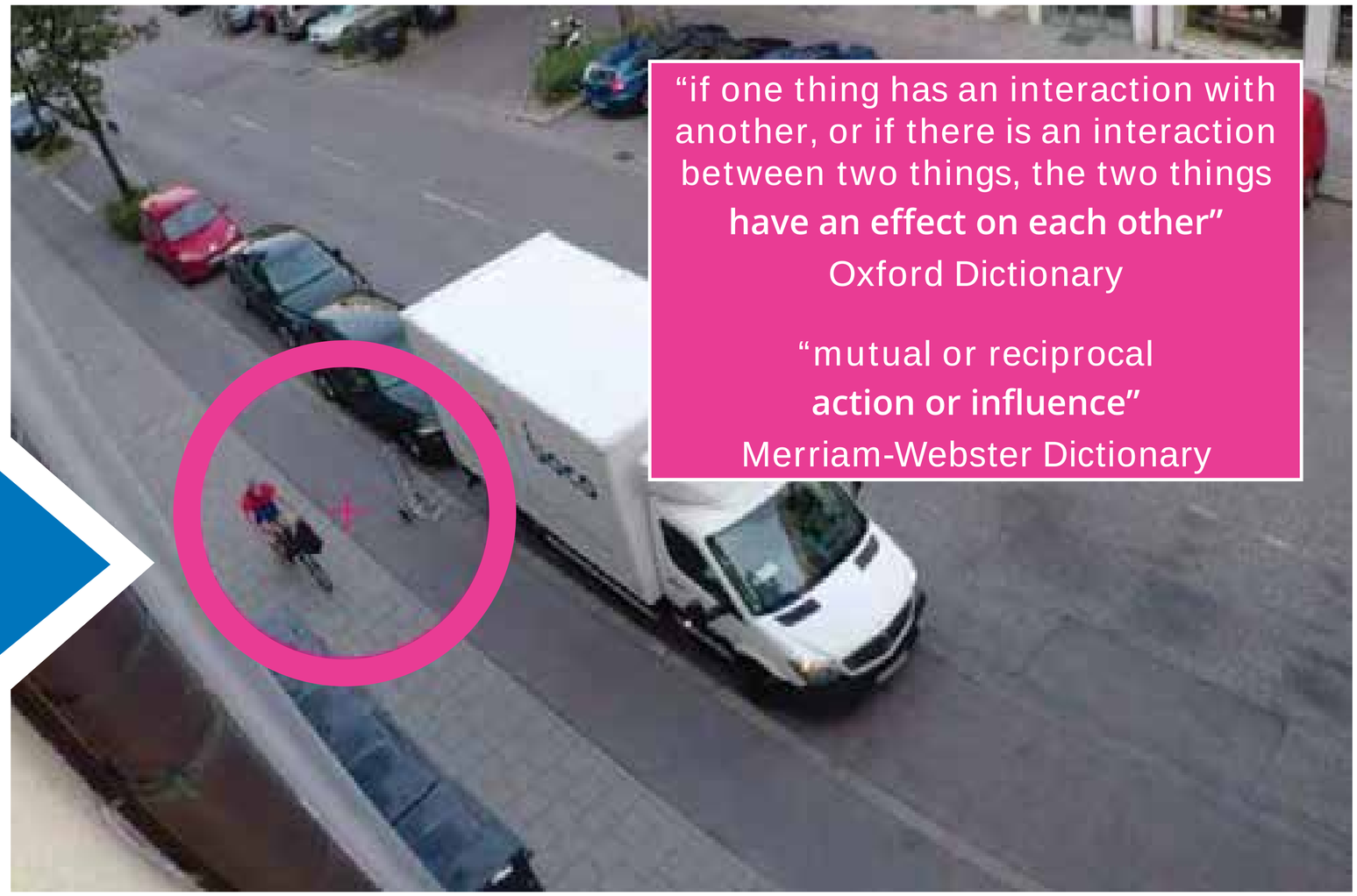
DEFINING AN EVENT

Observe Interactions

Define Variables

Discover Interaction Type

Analyze Interactions



"if one thing has an interaction with another, or if there is an interaction between two things, the two things **have an effect on each other"**
Oxford Dictionary

"mutual or reciprocal **action or influence"**
Merriam-Webster Dictionary

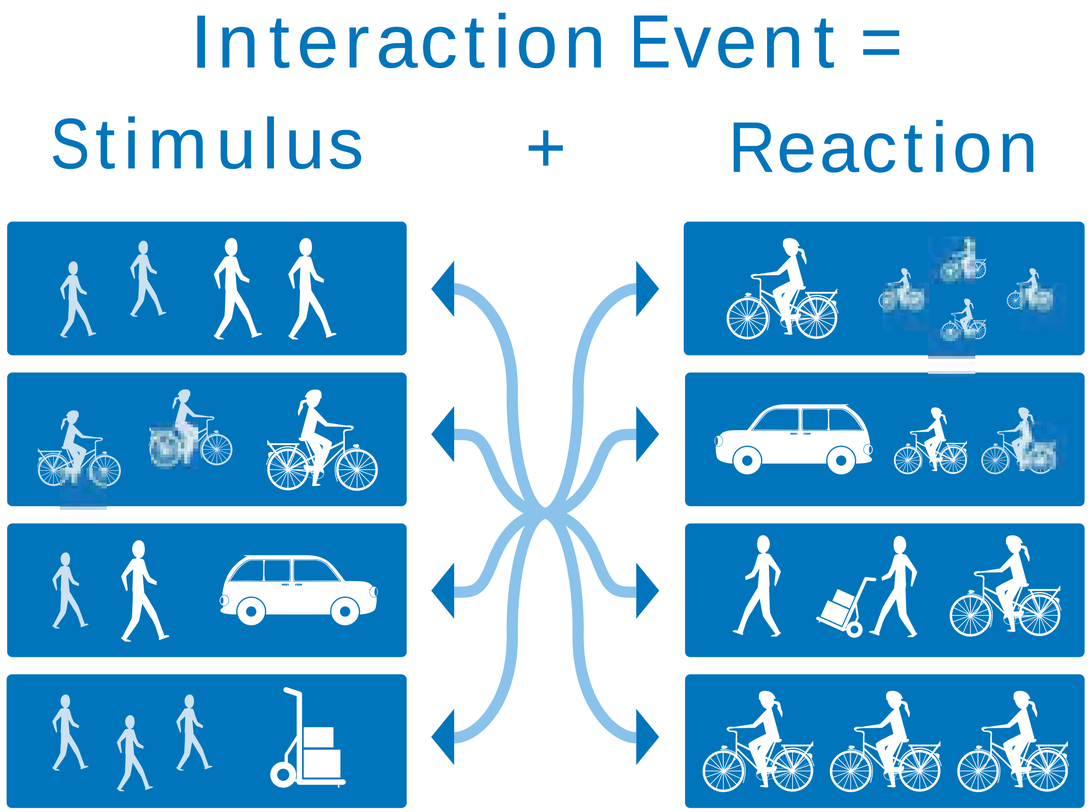
DEFINING AN EVENT

Observe Interactions

Define Variables

Discover Interaction Type

Analyze Interactions



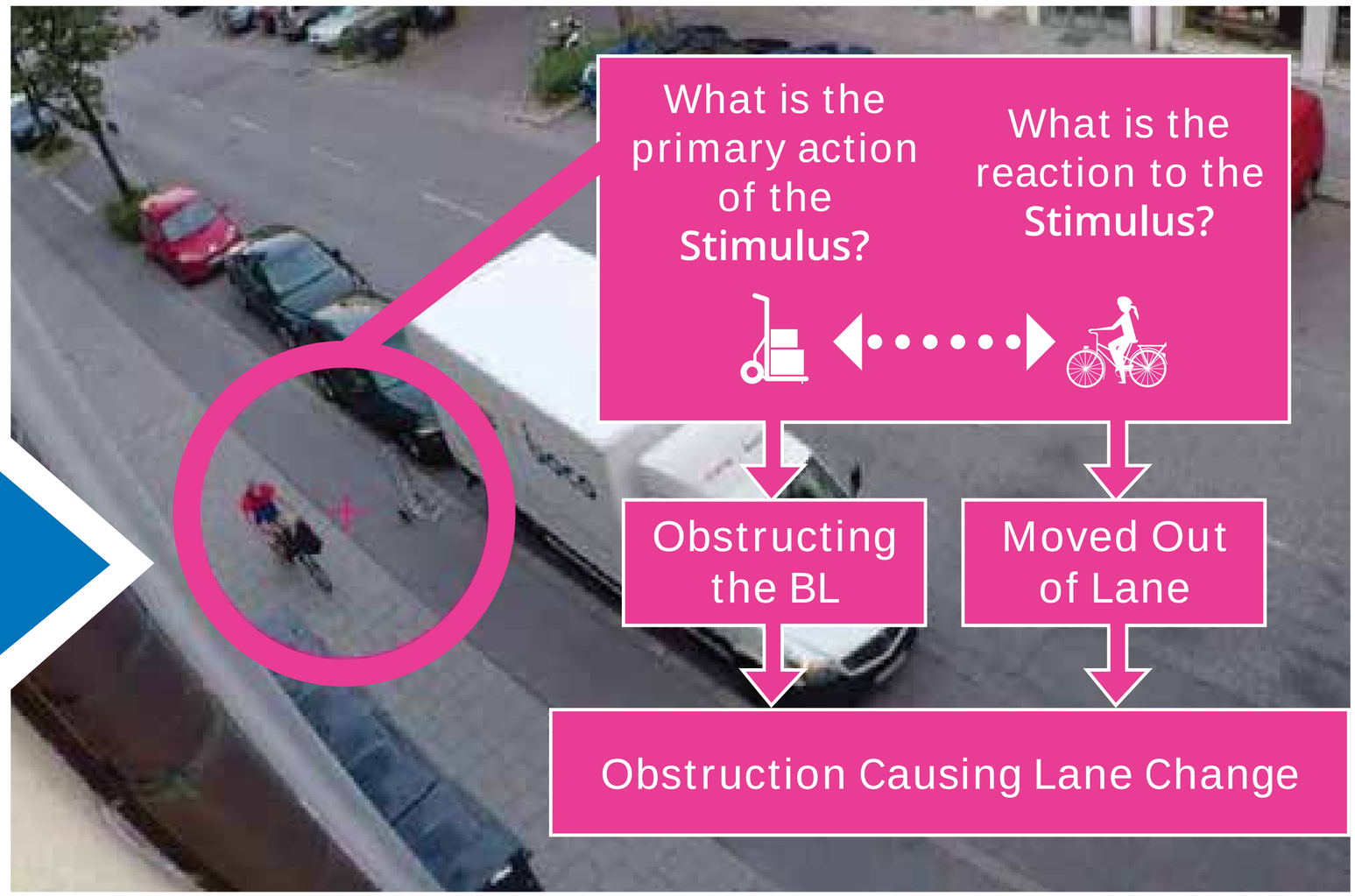
DEFINING AN EVENT

Observe Interactions

Define Variables

Discover Interaction Type

Analyze Interactions



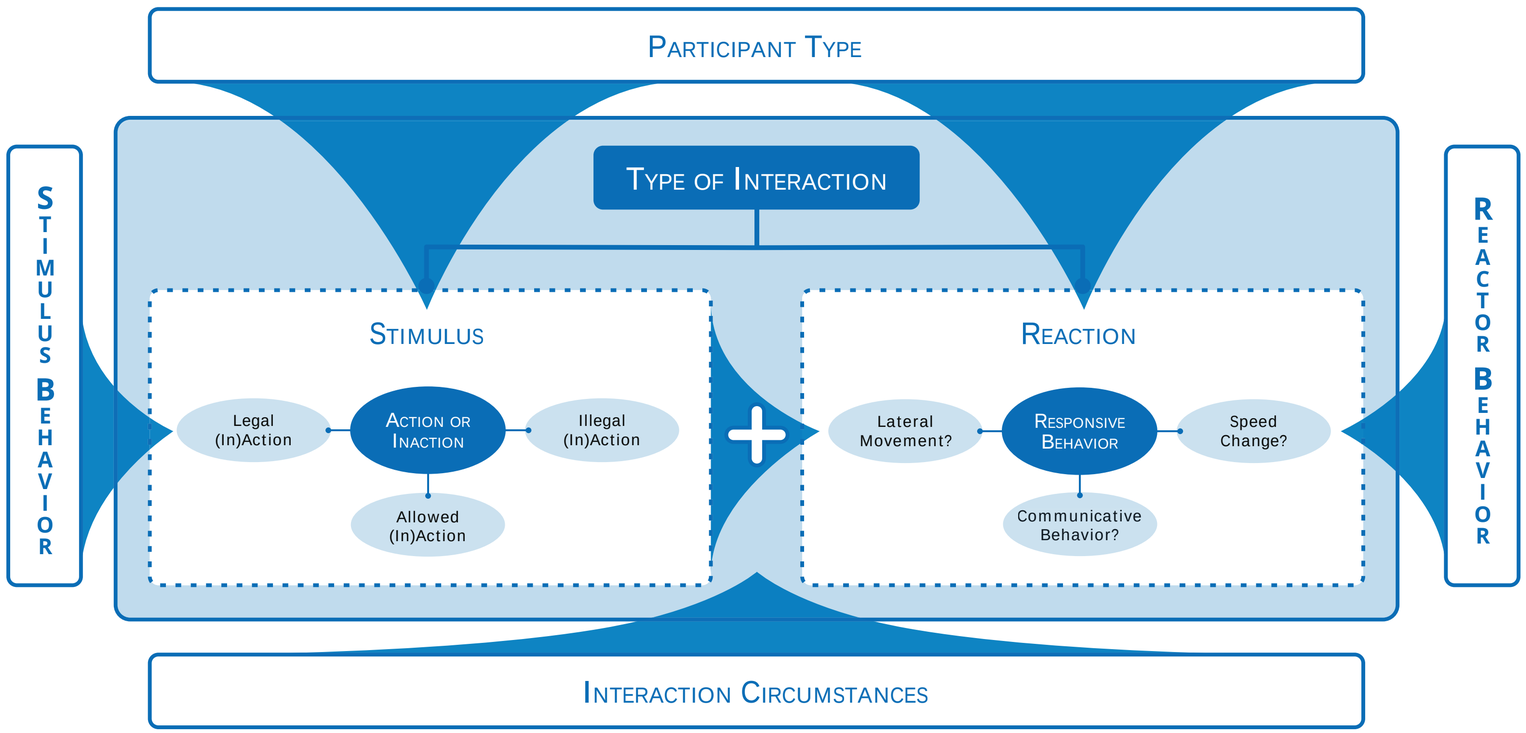
RESEARCH METHOD

Observe Interactions

Define Variables

Discover Interaction Type

Analyze Interactions



Interaction Type = (Stimulus + Reaction)

= *f* (Participant Type + Stimulus Behavior + Reactor Behavior + Interaction Circumstances)

CASE STUDY COMPARISON

CASE STUDY COMPARISON

ON-STREET BICYCLE LANES

280 Observed Interactions

08:15 to 20:01
Duration: 11hrs 46min

0.4 Interactions per Minute

BICYCLE LANES ALONG THE SIDEWALK

1208 Observed Interactions

07:48 to 20:16
Duration: 12hrs 28min

1.6 Interactions per Minute

ON-STREET BICYCLE LANES

	STIMULUS		REACTION
13.2%	Bicyclist Passing Other Bicyclist • 97.3% Move to VL to Pass	→	Bicyclist Being Passed Does Not React
8.2%	Bicyclist Passing Other Bicyclist • 91.3% Move to VL to Pass	→	Bicyclist Being Passed Adjusts Position in BL
5.4%	Vehicle Obstructing BL • 86.7% are Standing Vehicles	→	Bicyclist Changes Lanes
5.4%	Pedestrian Crossing the Street • 53.3% Yield Before Crossing BL	→	Bicyclist Adjusts Position in BL

BICYCLE LANES ALONG SIDEWALK

	STIMULUS		REACTION
21.0%	Multiple Pedestrians on SW	→	Bicyclist Adjusts Position in BL
	• 89.4% Do Not React to Bicyclist		
12.0%	Single Pedestrian on SW	→	Bicyclist Adjusts Position in BL
	• 81.4% Do Not React to Bicyclist		
4.2%	**Multiple Different Stimuli**	→	Bicyclist Adjusts Position in BL
	• 66.8% Do Not React to Bicyclist		
2.3%	Vehicle Standing DW	→	Bicyclist Adjusts Position in BL
	• 100% Do Not React to Bicyclist		

RESEARCH QUESTIONS

What Types of Interactions Do Bicyclists Experience When Traveling Along Streets with Unprotected Bicycle Lanes?

New Insights into Interaction Typologies

Do the type of interactions bicyclists experience differ on streets with different types of unprotected bicycle lanes in place?

Do bicycle lanes function to serve the safety, mobility, and access needs of all people traveling along the street segment?

OUTLOOK AND APPLICATIONS

- Evaluation of Case Study Sites:
  Findings can be used to evaluate the existing bicycle lanes and generate design standards **and traffic regulations to avoid undesirable/unsafe interactions.**

- Inform Existing and Future Research on Bicyclists' Interactions:
  Future research can investigate how road users perceive the discovered interactions to identify those with the greatest impact on subjective safety.

- Inform Understanding of User Behavior in Other Contexts:
  The grounded theory-driven observational method can be used to investigate interactions/behaviors on other types of infrastructures and public spaces.

- Provide Insights into Impacts of Emerging Micro-mobility:
  Exploratory studies using this method can be used to help us understand how e-scooter user behaviors; how they use the roadway and how they interact with other mode users.

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Questions?

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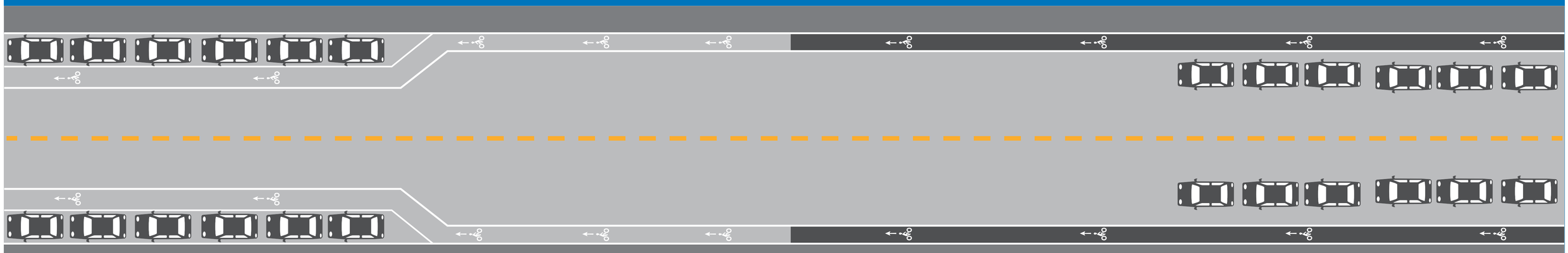

https://www.sv.bgu.tum.de/en/mobillab/doctoral-researchers/kollegiaten/cat-silva/

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