

S02 Project: Integration of Analysis Methods and Development of Analysis Plan



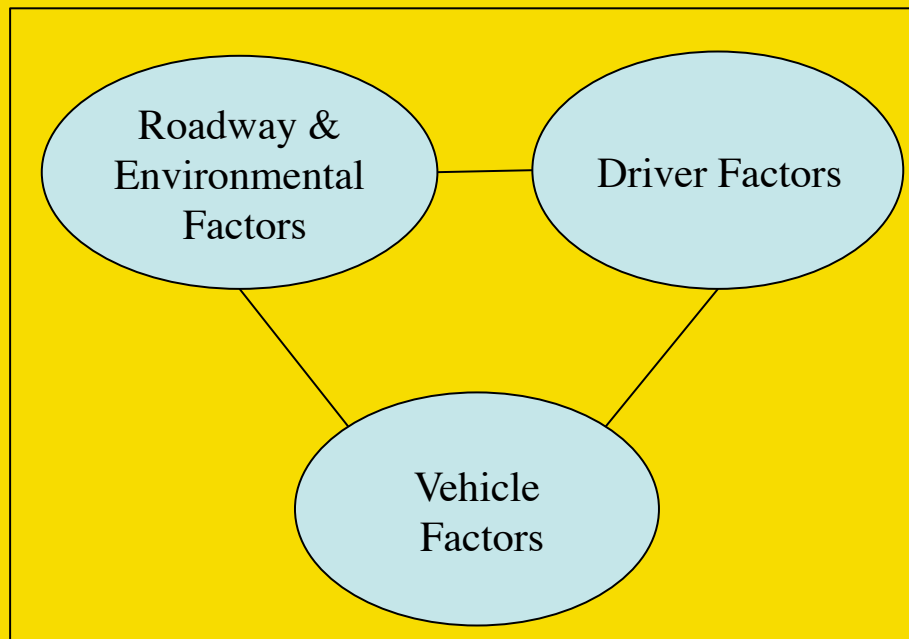
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***4th SHRP2 Research Symposium
Keck Center
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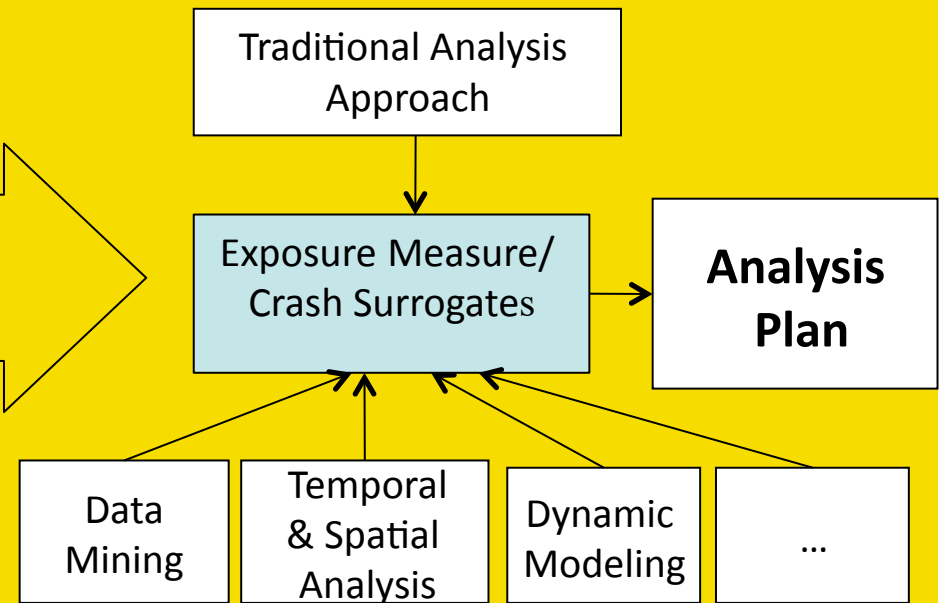
Objectives of S02

- Produce a framework for work plans applied to S08 research proposals
- Taking into consideration
 - data available from the in-vehicle instrumentation (S05)
 - roadway data as available (S03)
 - analytical methods (from S01)

Driver-Vehicle-Roadway Factors and Interactions



Systems-Based Approach to Analysis Plan Development



Work Plans: A Guiding Framework

- Specific outcomes that have tangible safety benefits
- Focused on high-priority safety-related research questions
 - Specify data needs
 - Consider needed data segmentation/aggregation
 - Justify analytical tools
 - Support safety interventions

S02 Phase I: Question integration and prioritization

- Collected research questions from:
 - (S01) PSU, ISU, UMTRI, UMN
 - (S05) VTTI/Battelle
 - Prioritized research questions
- Identified global research questions and initial priorities based on safety perspective

Global research questions

- Prioritized using a systems perspective
 - 56 research questions from S01 contractors
 - 392 research questions from S05 contractors
- Grouped according to similar
 - Safety outcomes
 - Explanatory variables (driver, vehicle, roadway, environment)
 - Characteristics of explanatory variables (static, dynamic)

Example input questions: aggressive behavior and crash likelihood

What is the relative contribution of **aggressive driving** to inappropriate gap acceptance?

What is the relative contribution of **aggressive driving** to red light running?

What is the role of **aggressive driving** in rear end crashes (striking vehicle in travel lane)?

To what degree does the lead vehicle driver (i.e., 'our driver') contribute to the crash due to **aggressive driving**?

What is the role of **aggressive driving** as it relates to crashes involving pedestrians, objects, and animals in the travel lane?

How does **aggressive driving behavior** impact crash/near crash risk?

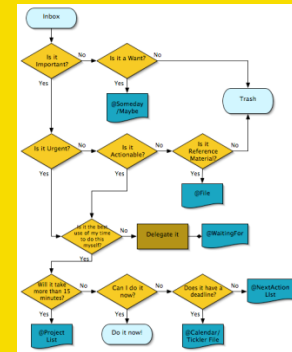
Why do **aggressive driving behaviors** occur and how do they relate to ROR crashes/near crashes?

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Decision tree developed

- Rationale way to prioritize the global questions
- Emphasis on questions that
 - Require naturalistic data on drivers
 - Support safety interventions
 - Provide insights into the causes of injuries and fatalities
 - Feasible given the dataset



Multiple perspectives

- Decision tree could have been viewed with respect to:
 - Basic scientific knowledge on driver behavior
 - Methodological approaches
 - Applied directly to safety and development of crash countermeasures
- We chose the Applied perspective based on the primary goal of S02

Global Research Questions

- 27 global research questions developed
 - 16 SHRP 2 (safety) related
 - 11 non-related/out of scope (unranked)
- Revised through iterations with SHRP 2 staff
- Central themes include:
 - Defining good crash surrogates
 - Influence of driver behavior on crash likelihood
 - Influence of roadway improvements

Priority 1 Topics

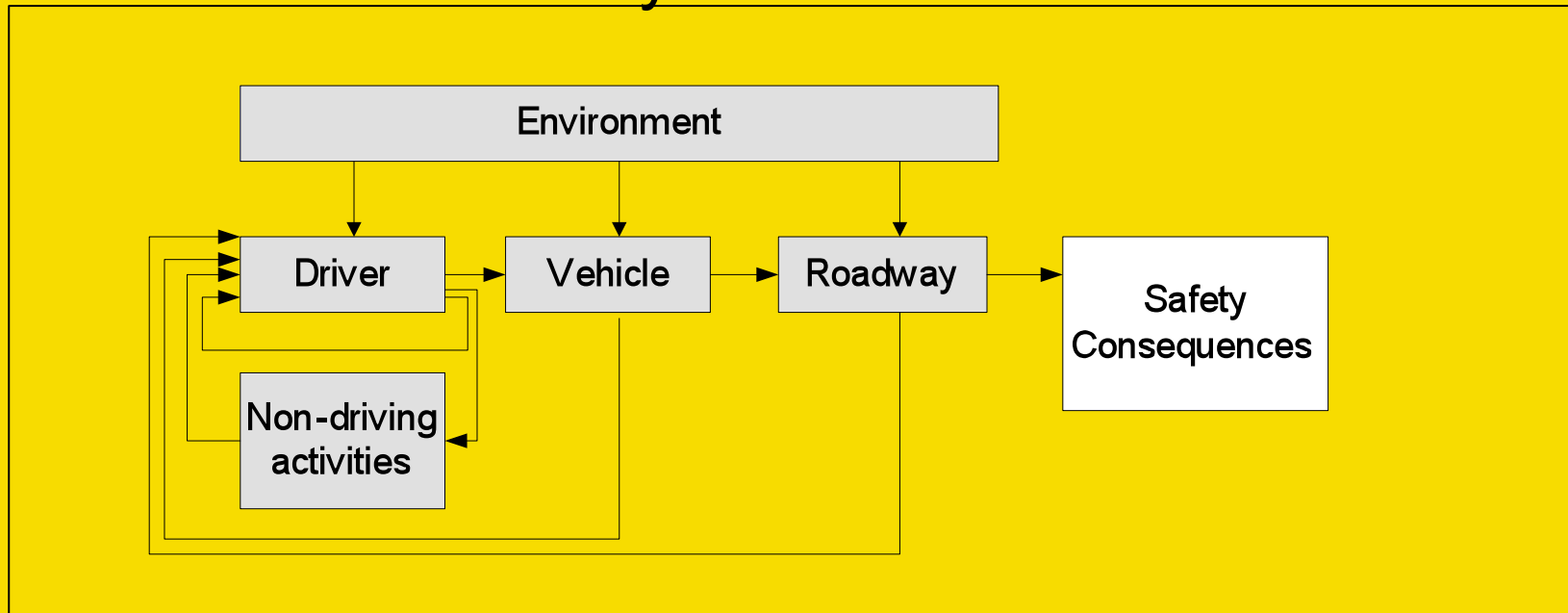
- Driver distraction and crash likelihood
- Driver fatigue and crash likelihood
- Driver impairment on crash likelihood
 - Alcohol, drugs
- “Aggressive” behavior and crash likelihood

Priority 1 Topics (cont.)

- Driver interaction with roadway features and lane departure crash likelihood
- Driver interactions with intersection features (configuration and operations)
- Advanced driver support system effects
- Crash surrogate measures

S02 Phase II: Work plan development

- Develop guiding framework for RFPs that consider the breadth of explanatory variables and data from the study

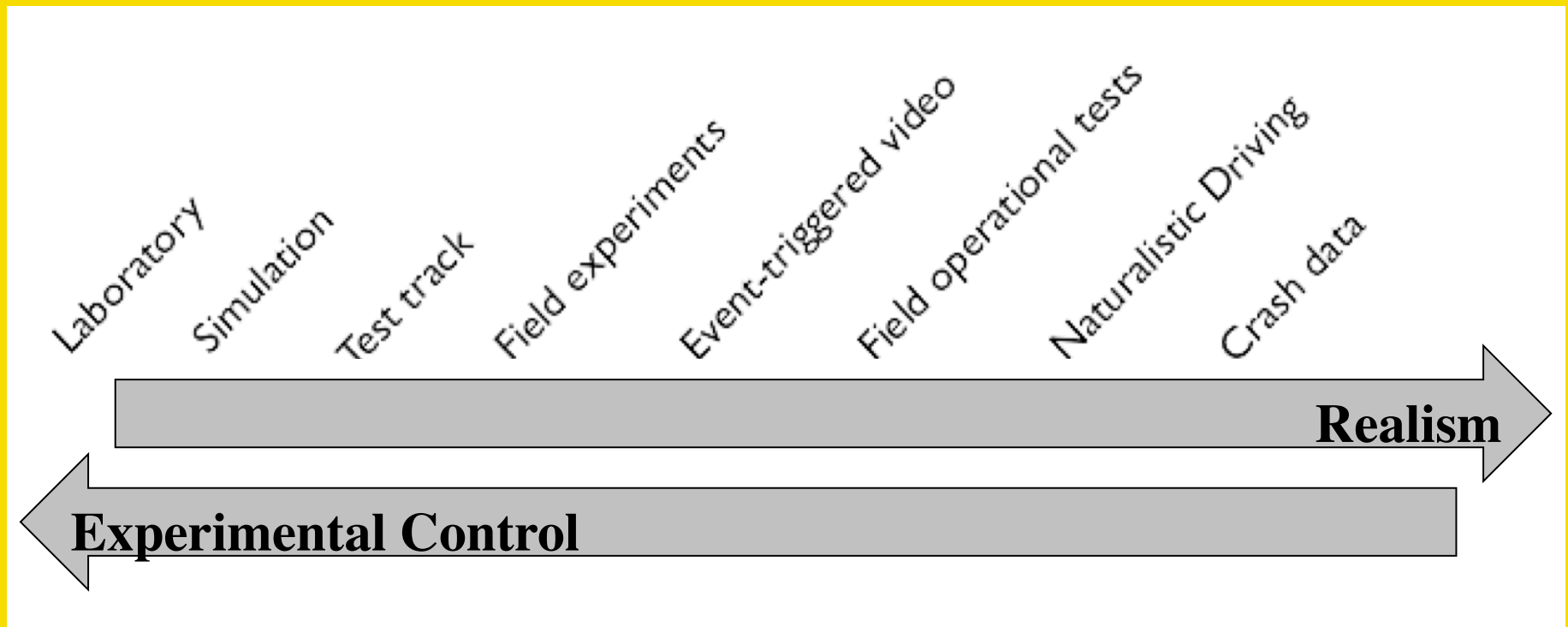


S02 Phase II

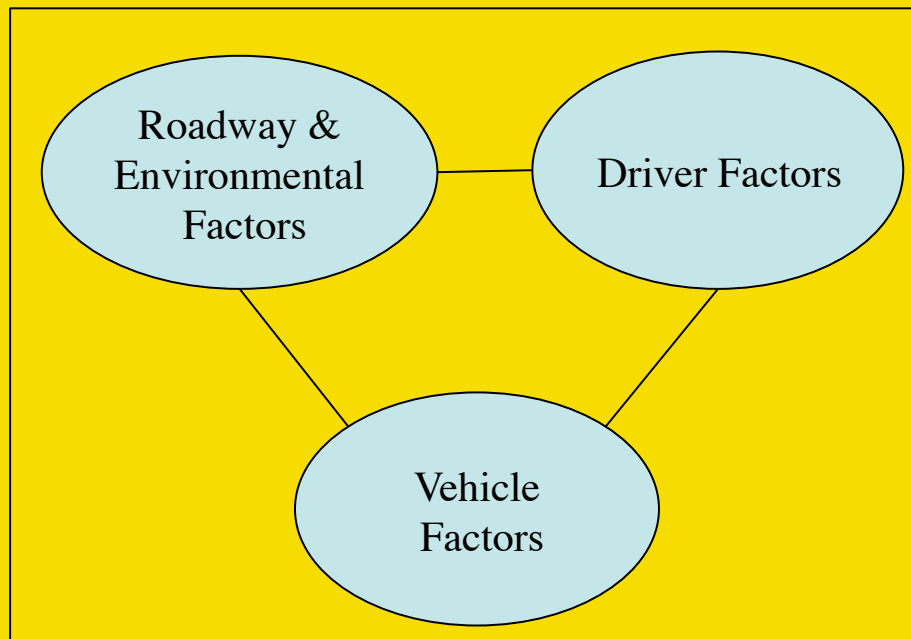
- In coordination with S01, S03, and S05
 - Highlight outcomes and most useful recommendations for SHRP2
 - Provide useful insights gained and the limitations observed
 - Tips and techniques
 - Document and summarize data elements available for final work plans

S08 Work plan considerations

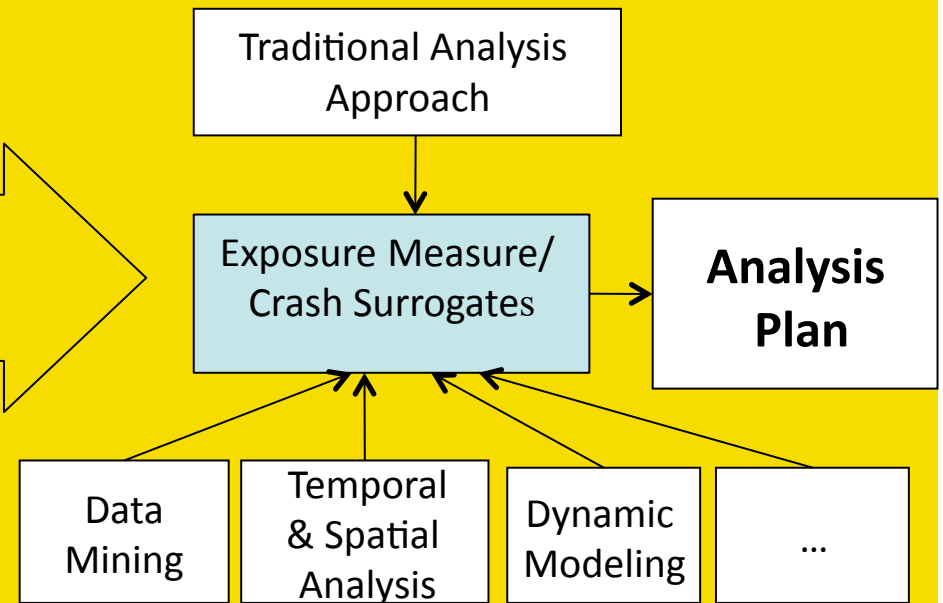
1. What explanatory variables are relevant to the research question?
2. What is the appropriate level of data aggregation to observe relevant safety consequences?
3. What analytical tools are needed?



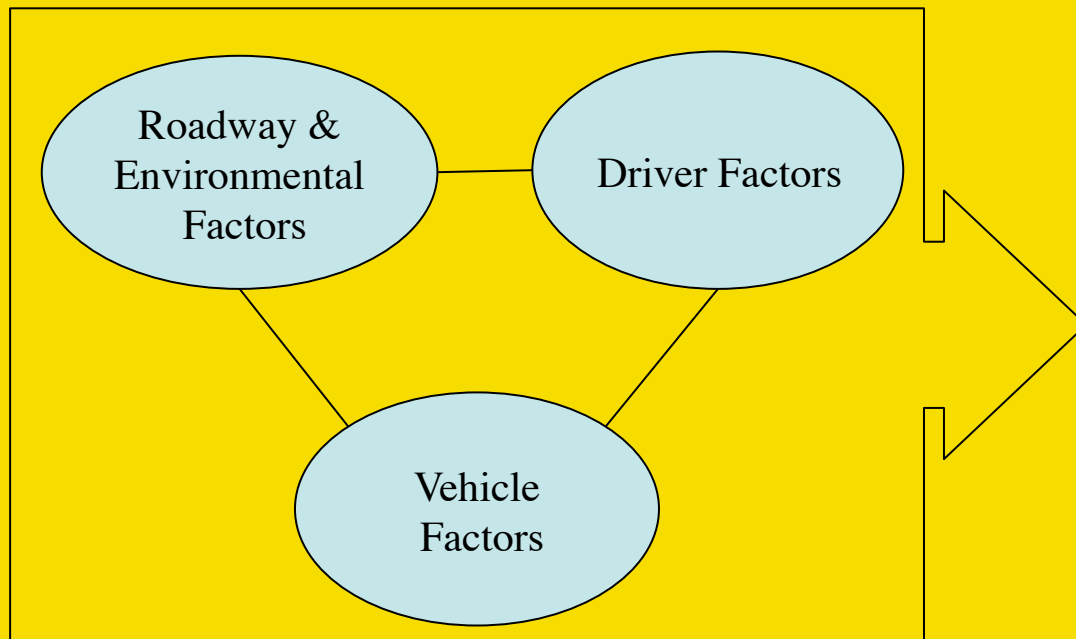
Driver-Vehicle-Roadway Factors and Interactions



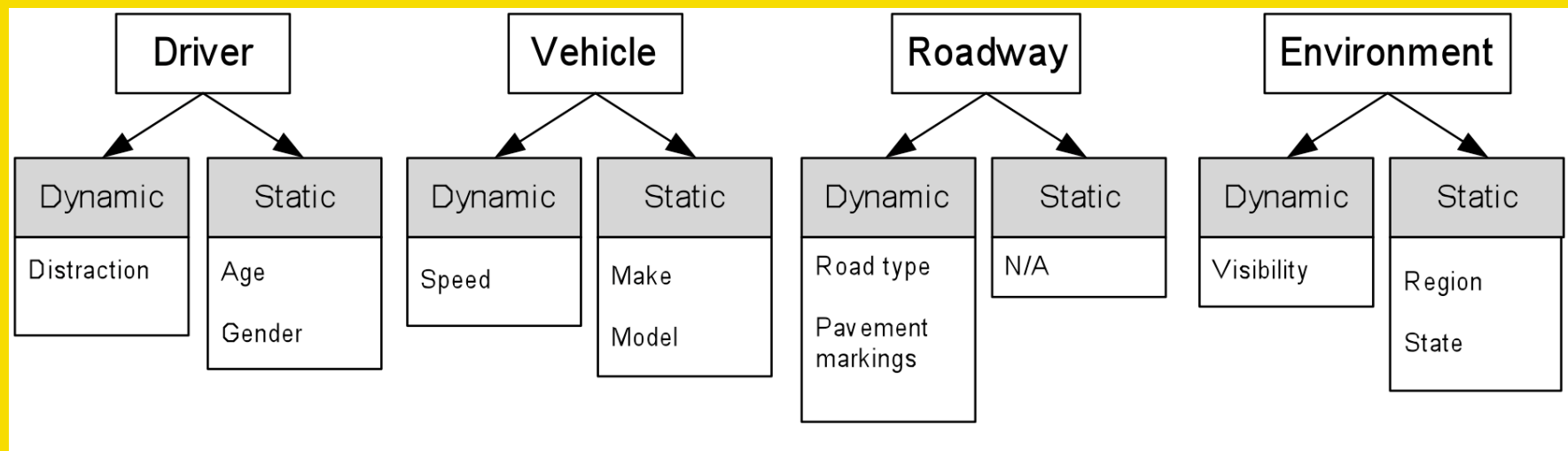
Systems-Based Approach to Analysis Plan Development



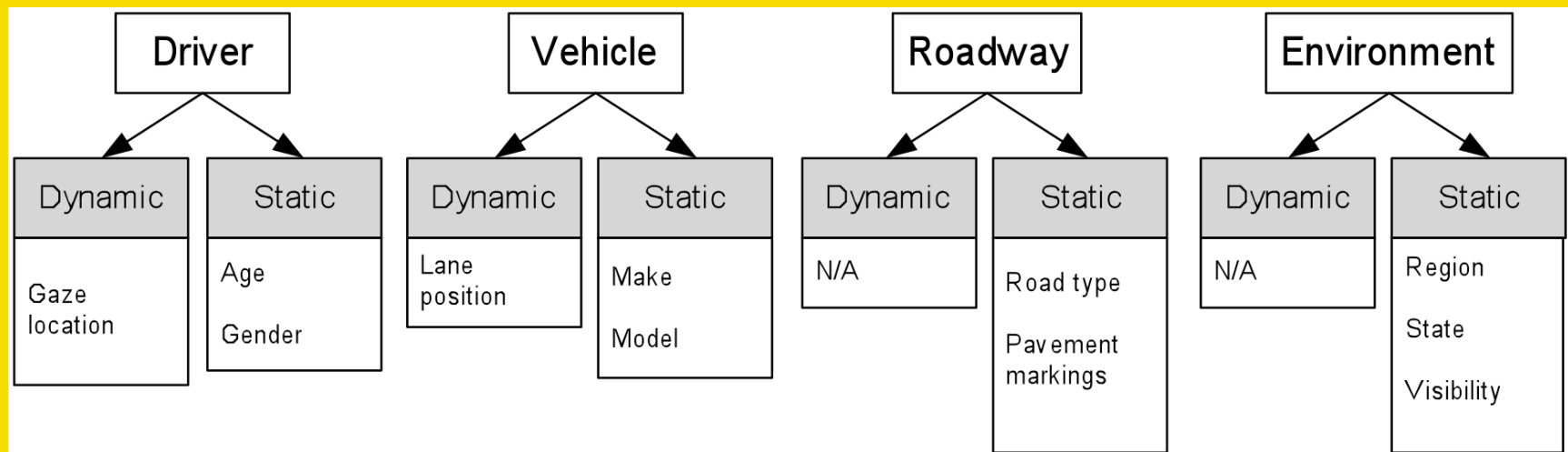
Driver-Vehicle-Roadway Factors and Interactions



Dynamic and static characteristics at the trip level



Dynamic and static characteristics at the event level



Data Segmentation

Explanatory

	Continuous	Sequential Blocks	Sample based	Event (Trigger) based
Driver				
Vehicle				
Roadway				
Environment				

Data Segmentation

Continuous (raw)



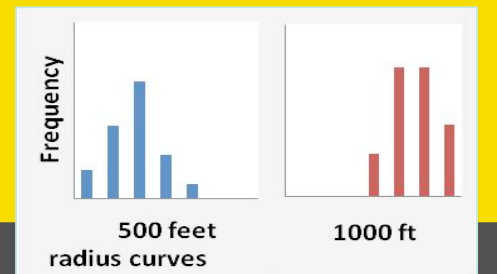
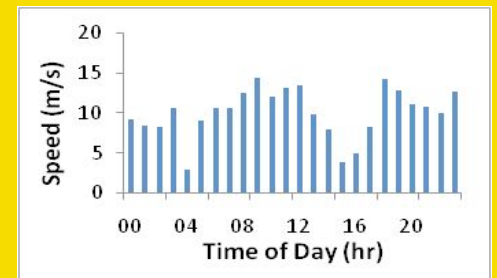
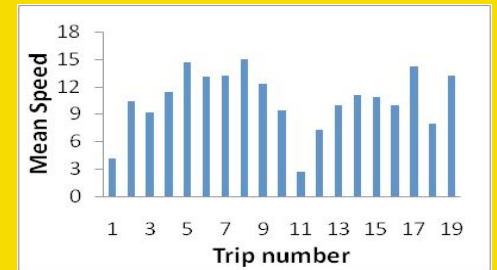
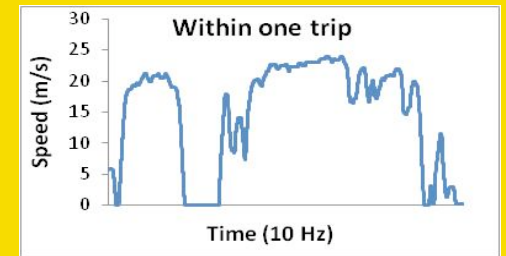
Sequential Blocks



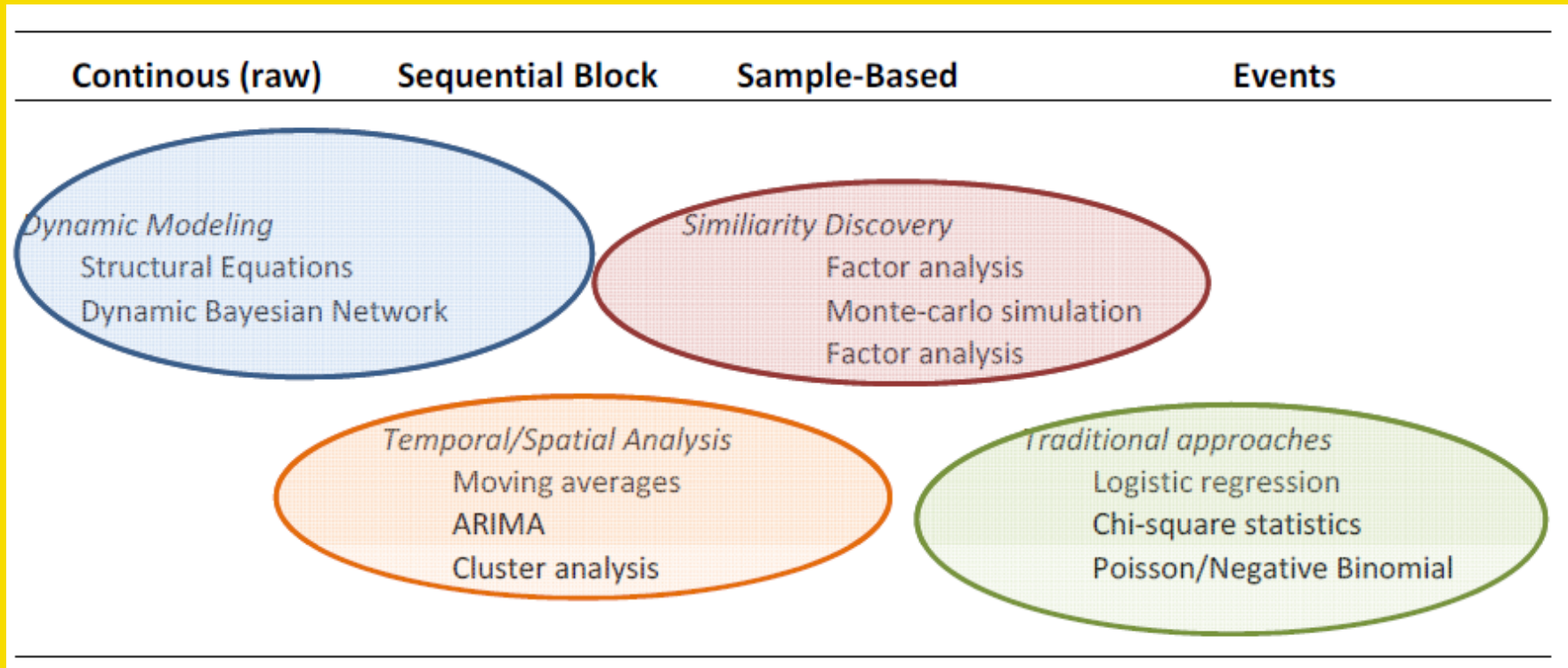
Sample based



Events (triggered)



Examples of Data Analysis



Data Example 1. Continuous, Driver

What are the different signatures of speed modulation to predict distracted driving?

	Continuous	Sequential Blocks	Sample based	Event (Trigger) based
Driver				
Vehicle				
Roadway				
Environment				

- Continuous data: highest resolution after cleaned and filtered
- Can provide the most detail

Data Example 2. Event (Trigger) based, Roadway

How does rumble strip placement affect the degree of overcorrection?

	Continuous	Sequential Blocks	Sample based	Event (Trigger) based
Driver				
Vehicle				
Roadway				
Environment				

- Data based on features/events/triggers of interest
- Provides research to supports design of safety interventions (e.g., rumble strip design)

Data Example 3. Sequential blocks, Environment

How do roadway conditions induce cumulative fatigue, as indicated by steering control?

	Continuous	Sequential Blocks	Sample based	Event (Trigger) based
Driver				
Vehicle				
Roadway				
Environment				

- Condenses data to blocks or epochs that summarize driver behavior over consecutive periods of interest (e.g., every minute, hour, or trip)
- More manageable and focused dataset

Data Example 4. Sample-based, Environment and driver

How does familiarity with the environment affect the glance patterns of older drivers?

	Continuous	Sequential Blocks	Sample based	Event (Trigger) based
Driver				
Vehicle				
Roadway				
Environment				

- Data samples focus on snapshots in time

Work plan outline

- Define unique research question
 - Based on 'real' problem (driver distraction, red light running)
- Model formulation
 - Sampling approach (from cells)
 - Database structure (data sharing)
 - Statistical analyses
 - Define a data reduction/ processing plan
- Model validation
- Account for computing time at VTTI
- Documentation of results
- Articulate expected outcomes in terms of safety interventions

Work plan considerations

- Need to consider/specify data requirements
 - Including other data sources
- Explanatory factors (predictors) and safety consequences (outcome measures) for each research question
- Specify characteristics of data set at given level of aggregation (e.g., size of sequential block)
- S06 contractors will provide potential researchers with continuous and trip level data

Work plan considerations

- Each work plan will focus on high-priority global research questions
 - With each proposal team tailoring their specific questions
- Ideally one month of data available for proposing team to examine
- Ideally list of data elements, frequency, and accuracy will be provided

Work plan considerations

- All data may not be available by first proposal cycle (e.g., roadside data)
- S06 data will include GPS time stamp and spatial information (lat, long)
 - Each team will need to identify what data variables are required and what they can synch (overlay) from other sources

Work plan considerations

- Selection of analytical technique
- Verification of method
- Identification of limitations with each dataset and analytical method applied

Work Plan Example 1

- **Global question:** *How does driver distraction influence crash likelihood?*
- **Example specific question**
 - Are teen drivers particularly vulnerable to distractions due to wireless devices (e.g, text messages, conversations on phone)?
- **Expected impact**
 - Guide GDL interventions to reduce distraction

Work Plan Example 1 (cont.)

- **Model formulation**
 - Sampling approach:
 - Event (trigger based): distraction occurrences based on wireless use
 - Using driver data by age
 - Data extraction, reduction, processing plan
 - Database structure (data sharing)
 - Data dictionary and operational definition
 - Statistical analysis
 - Risk ratios, logistic regression

Work Plan Example 2

- **Global question:** How does intersection configuration and operations influence driver behavior and crash risks?
- **Example specific question**
 - How do drivers' acceleration/deceleration patterns compare between coordinated and uncoordinated signalized intersection corridors (feature)? What is the effect on red light running crash risk?
- **Expected impact**
 - Guide interventions to signal timing

Work Plan Example 2 (cont.)

- **Model formulation**
 - Sampling approach:
 - Continuous data: speed, distance
 - Event based: flagged for signalized and unsignalized intersections
 - Data extraction, reduction, processing plan
 - Database structure (data sharing)
 - data dictionary and operational definition
 - Statistical analysis
 - Acceleration profiles, time-series modeling

Research Question Criteria

- Based on global research questions
 - Directed to SHRP2 safety goals
 - Demonstrate the utility of ND studies
 - Information that supports countermeasures for stakeholders

Recommendation

- Given staggered release of 5 to 8 RFPS
- RFP on crash surrogates is a foundational tool for the safety focus of SHRP2
- Some data may not be available by first proposal call (e.g., roadway data)
- Some questions more feasible now (e.g., driver fatigue)
- Complimentary to other studies (e.g, driver distraction)

Next steps

- Consensus for work plans
- Finalize availability of data elements
- Final reporting

Priority 1 Topics

- Driver distraction and crash likelihood
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