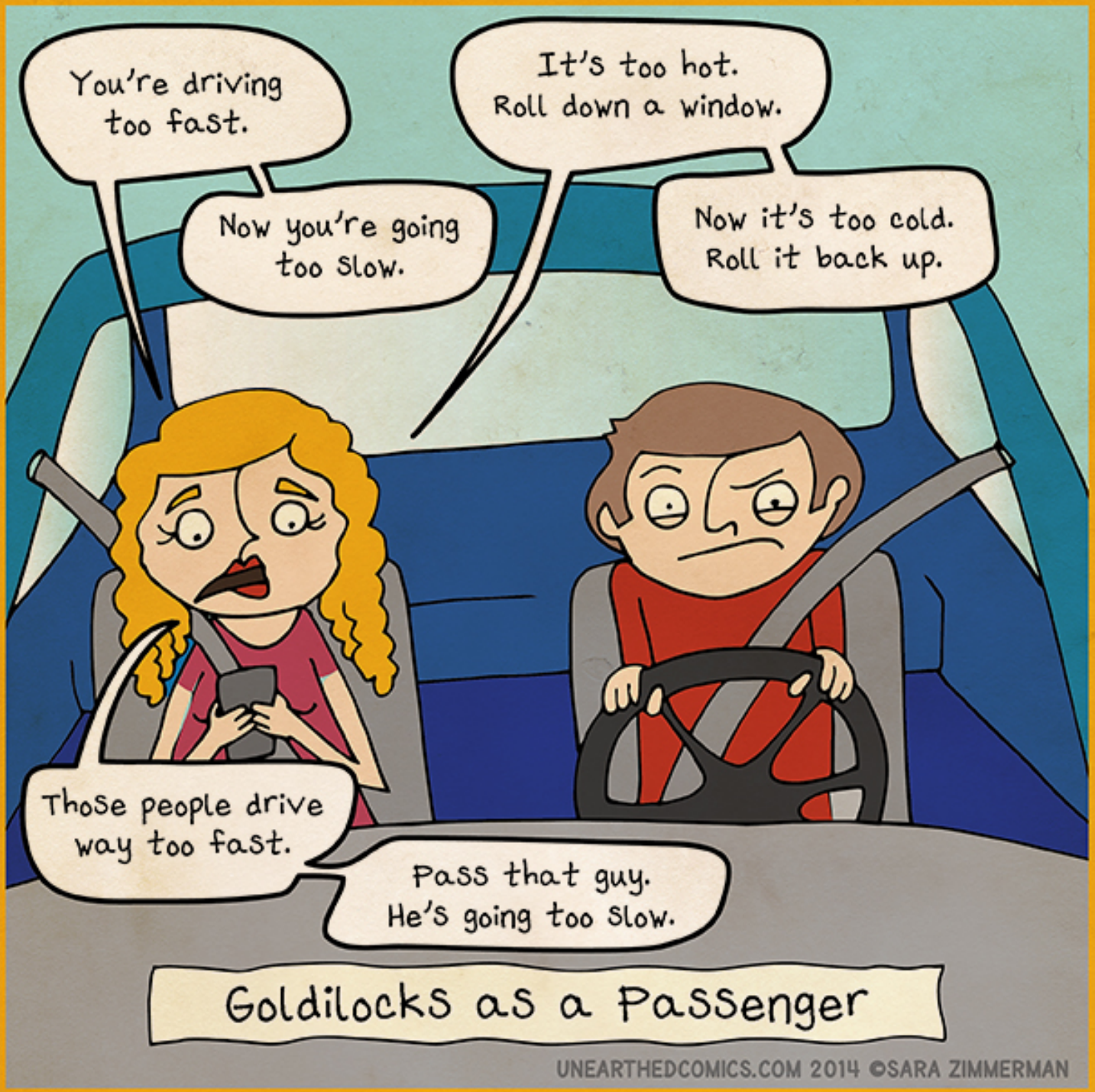
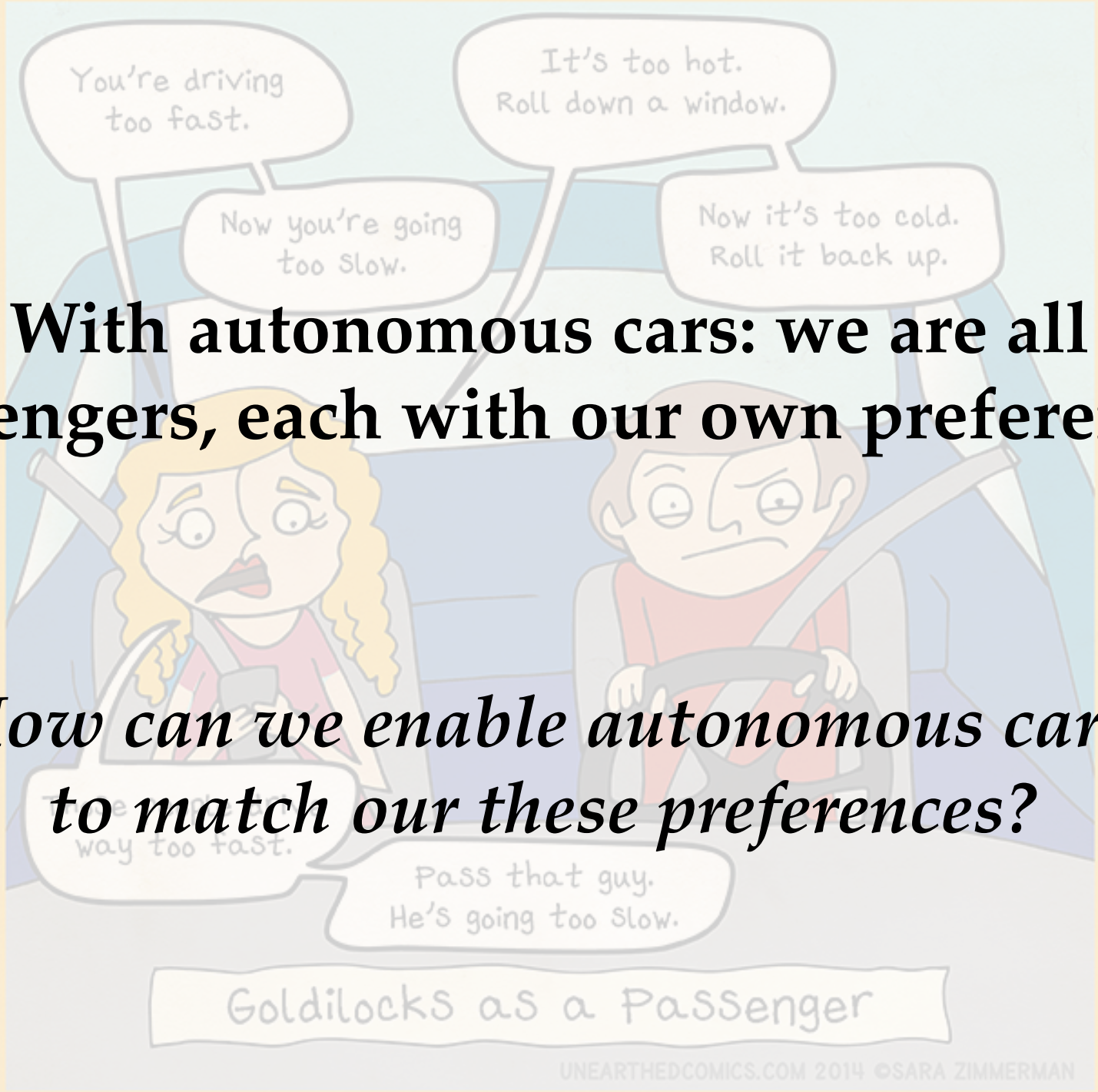
Do you want your car to drive like you?

Chandrayee Basu*
Qian Yang**
David Hungerman*
Mukesh Singhal*
Anca Dragan***

*UC Merced, **Carnegie Mellon, ***UC Berkeley


google.com/streetview


You're driving too fast.
Now you're going too slow.
It's too hot. Roll down a window.
Now it's too cold. Roll it back up.
Those people drive way too fast.
Pass that guy. He's going too slow.
Goldilocks as a Passenger
UNEARTHEDCOMICS.COM 2014 ©SARA ZIMMERMAN

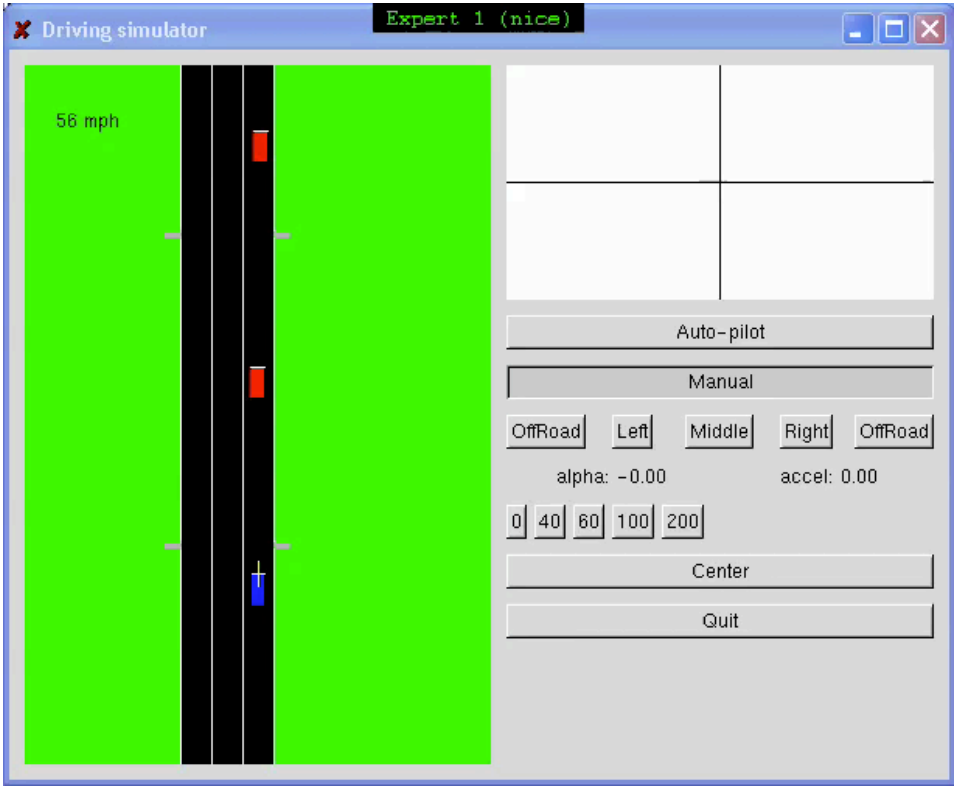


With autonomous cars: we are all passengers, each with our own preferences.

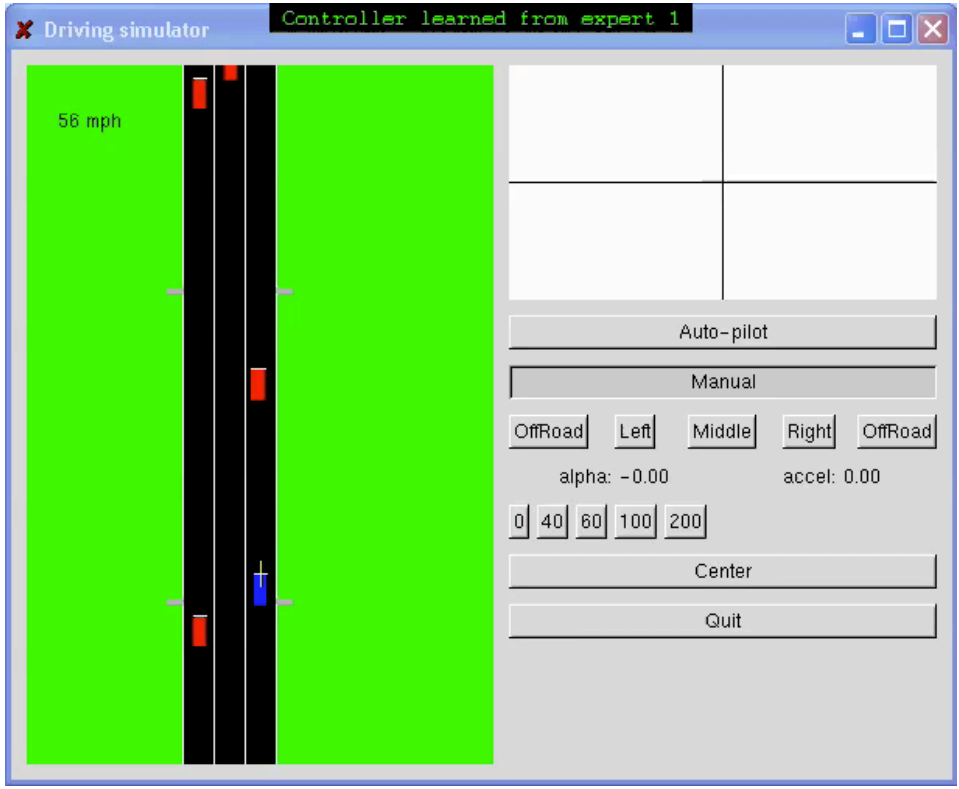
How can we enable autonomous cars to match our these preferences?

Learning Driving from Demonstration

EXPERT
(Owner of the car)



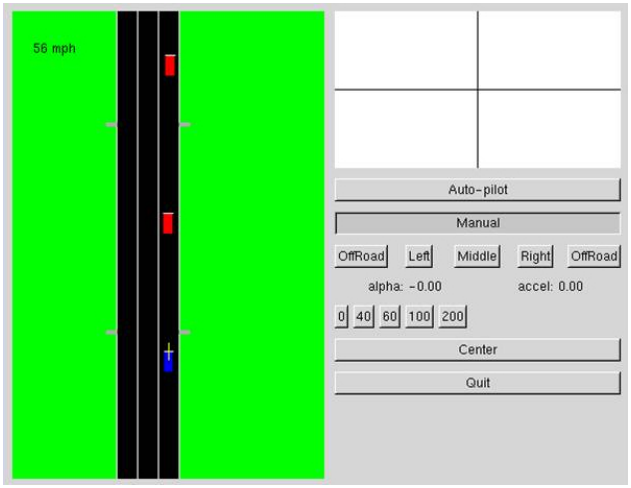
LEARNER
(Autonomous car)



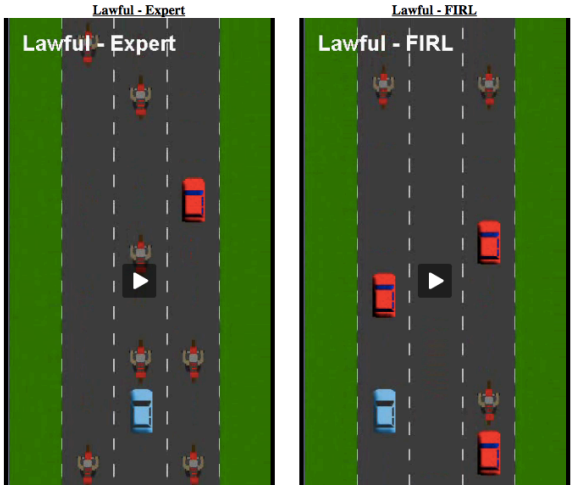
Source: http://ai.stanford.edu/~pabbeel/RL-videos.html

Learning Driving from Demonstration

[Pomerleau, 1989]



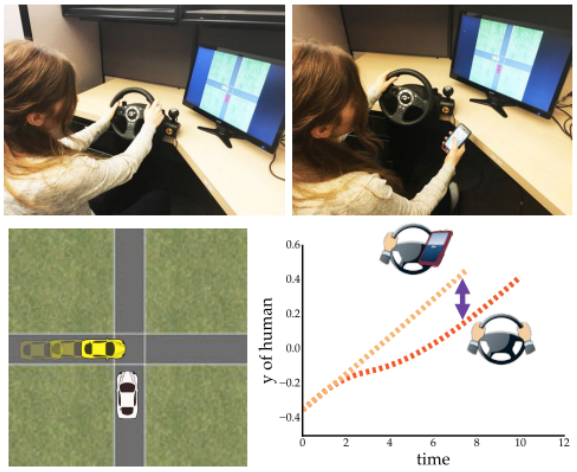
[Abbeel, 2004]



[Levine, 2010]

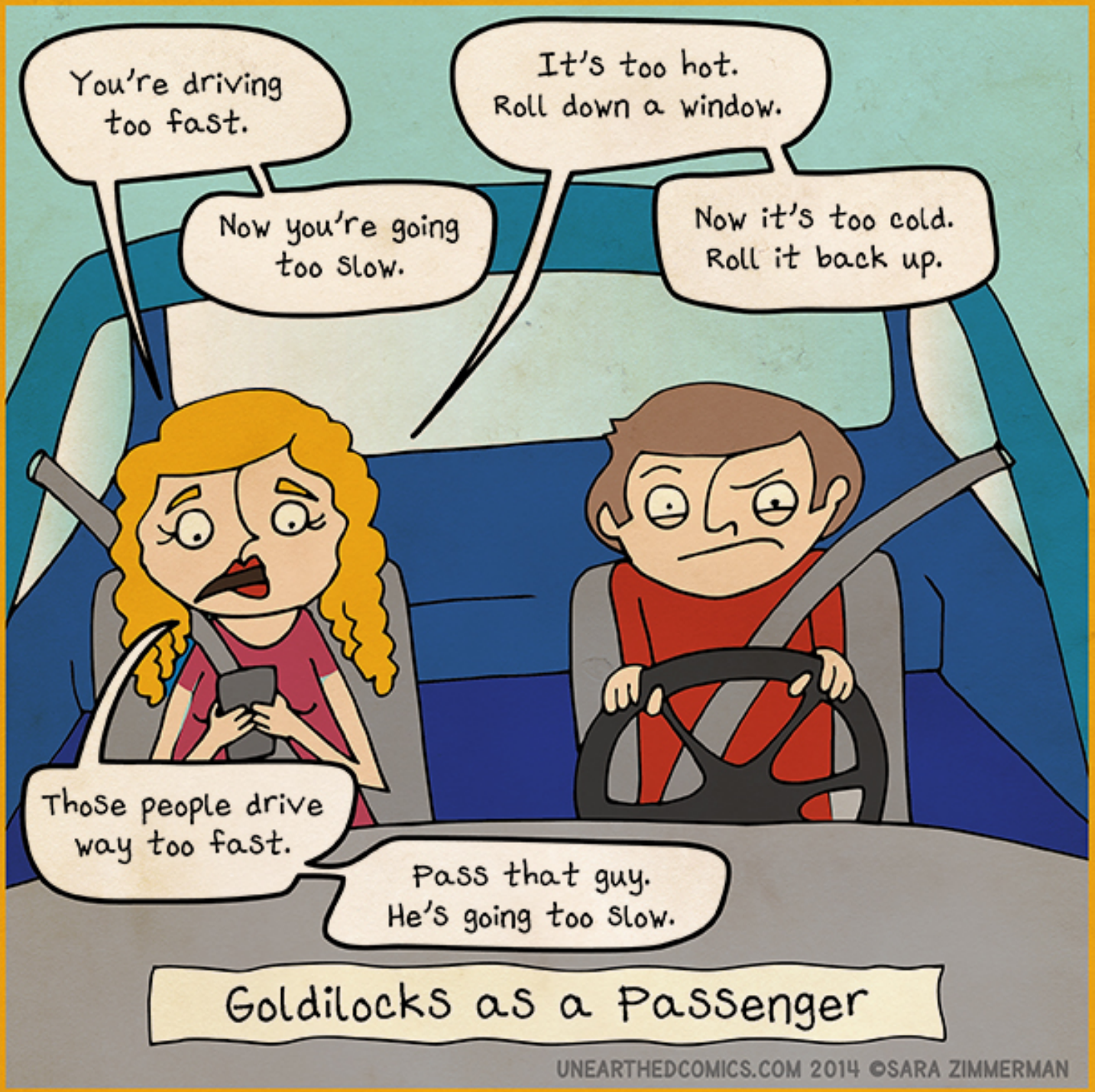
[Kuderer, 2015]

[Sadigh, 2016]



[Sadigh, 2016]

Learning driving style from demonstration assumes people want the car to drive like they do.


You're driving too fast.
Now you're going too slow.
It's too hot. Roll down a window.
Now it's too cold. Roll it back up.
Those people drive way too fast.
Pass that guy. He's going too slow.
Goldilocks as a Passenger
UNEARTHEDCOMICS.COM 2014 ©SARA ZIMMERMAN

Learning driving style from demonstration assumes people want the car to drive like they do.

What if they don't?

H. Users of autonomous cars prefer a driving style that is significantly different than their own.

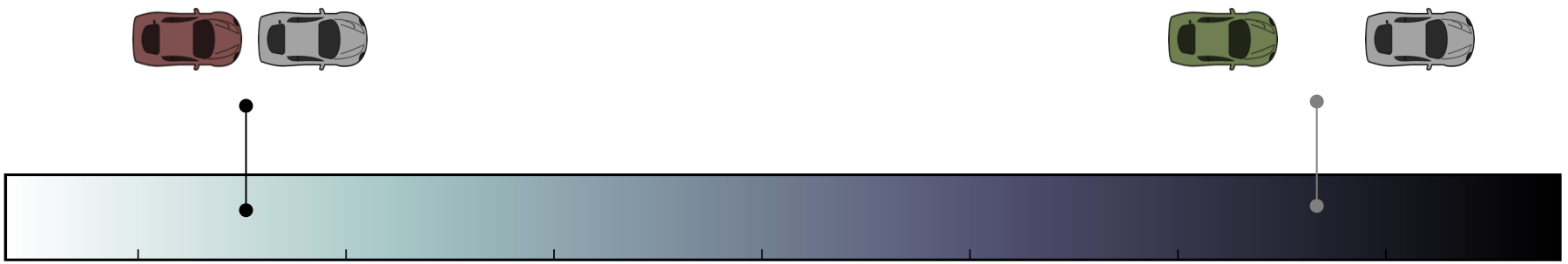
H. Users of autonomous cars prefer a driving style that is significantly different than their own.

Driving Styles

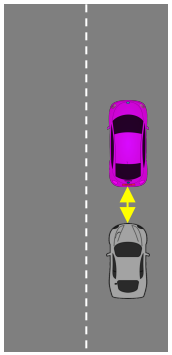
more aggressive

defensiveness = $w^T f$

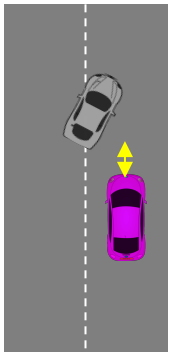
more defensive



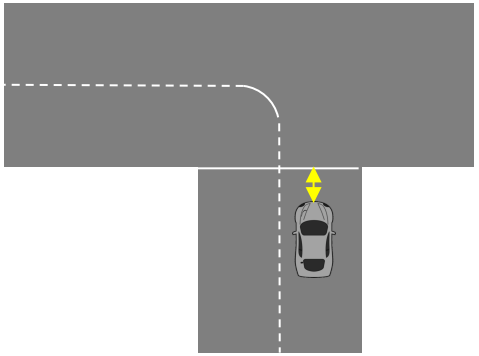
Features* *f*:



Distance headway with the lead car



Distance headway merge back

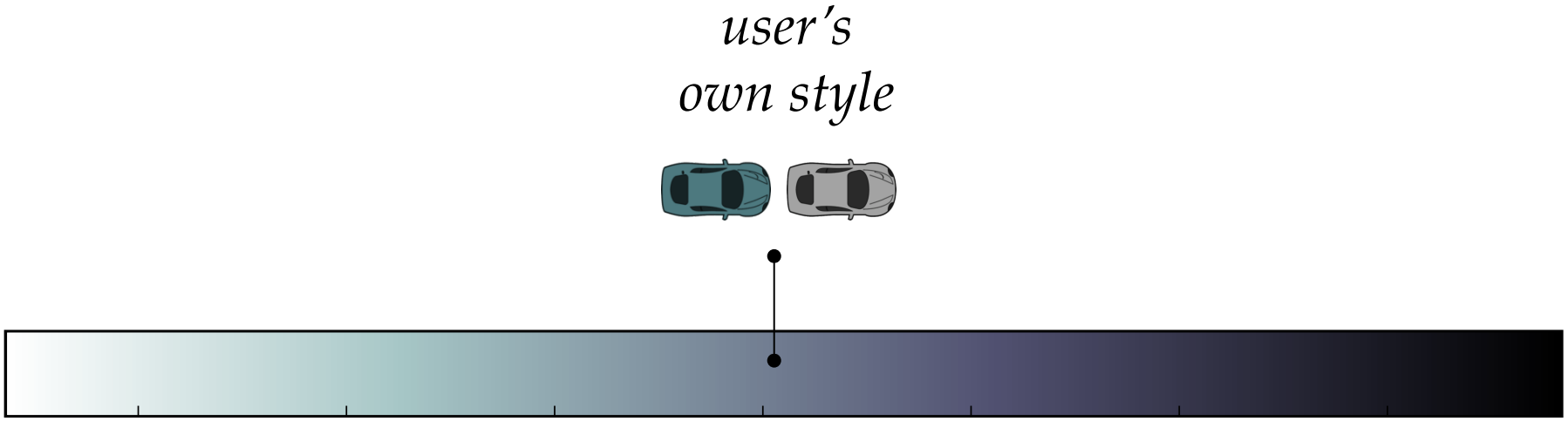


Braking at the intersection

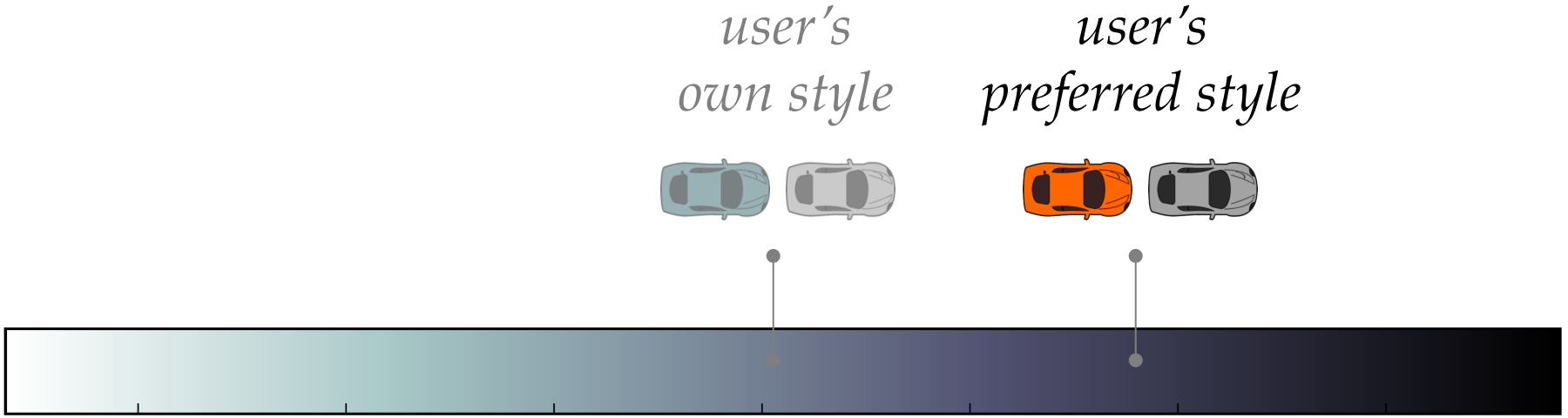
. . .

*Most of the features are derived from [Lee, 2004] [Hong, 2014] and [Banovic, 2016]

Hypothesis

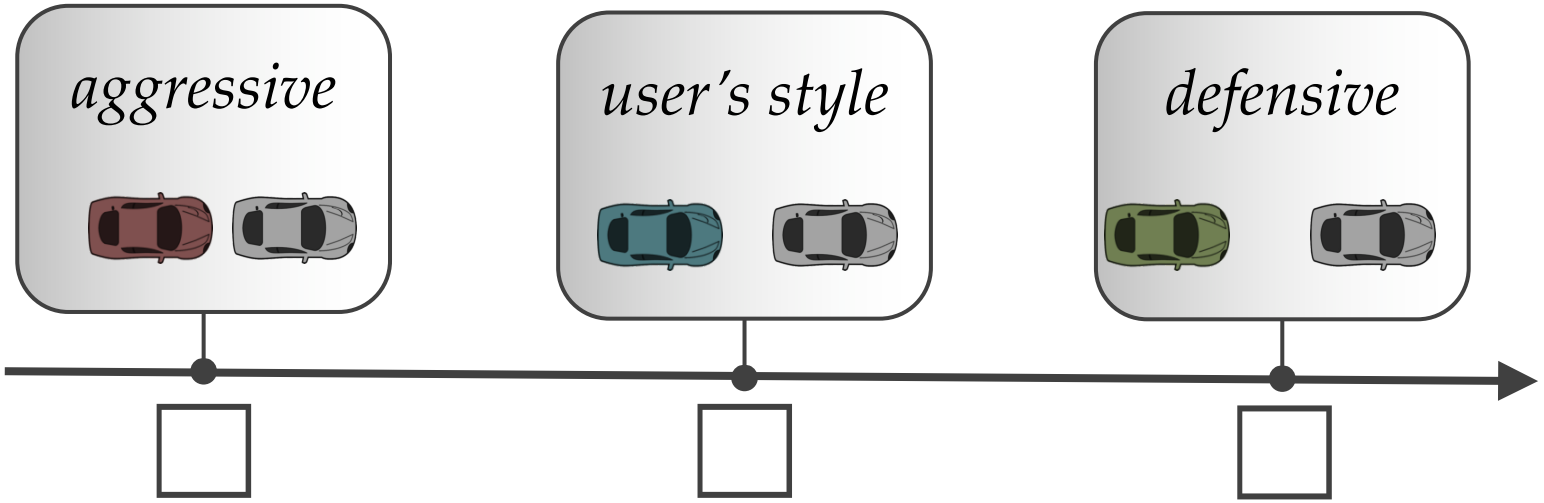


Hypothesis

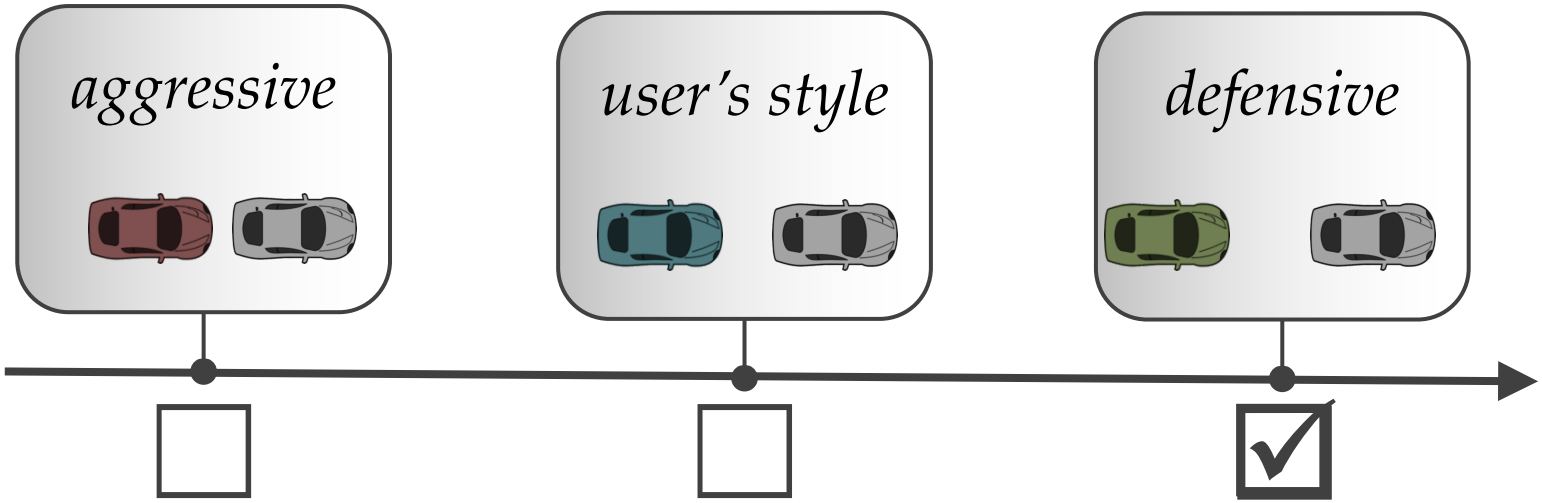


User Study (in Driving Simulator)

Manipulated Factor: Driving Style



Dependent Measures



Preference for daily use

	1	2	3	4	5	6	7	
Strongly disagree	○	○	○	○	○	○	○	Strongly agree

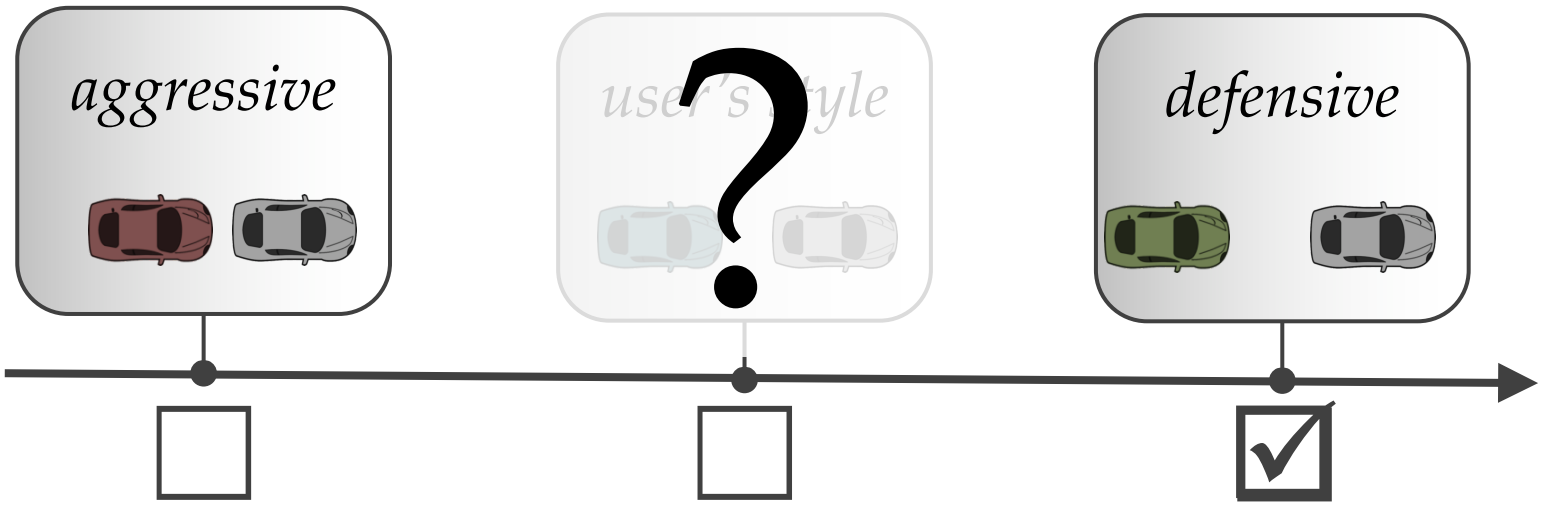
Perceived similarity with own driving style

	1	2	3	4	5	6	7	
Very different	○	○	○	○	○	○	○	Very similar

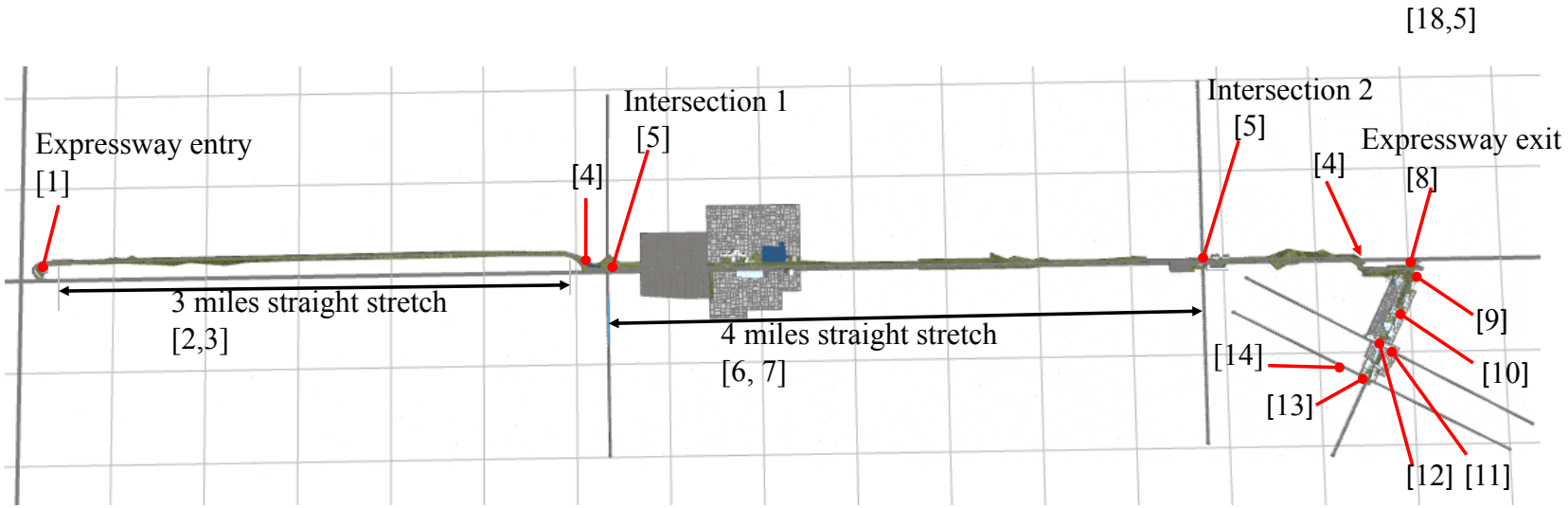
Dependent Measures

Preferred style: Highest rated style(s) in the preference question.

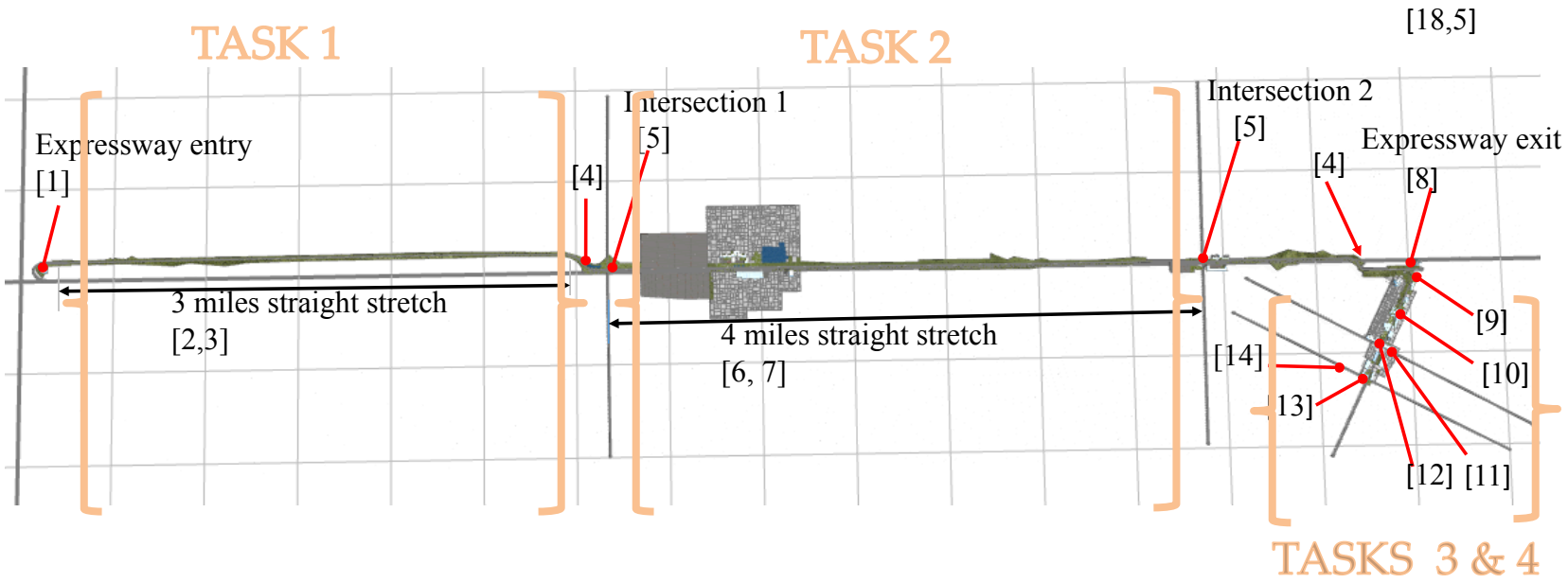
Perceived style: Highest rated style(s) in the perceived similarity question.


aggressive
?
defensive

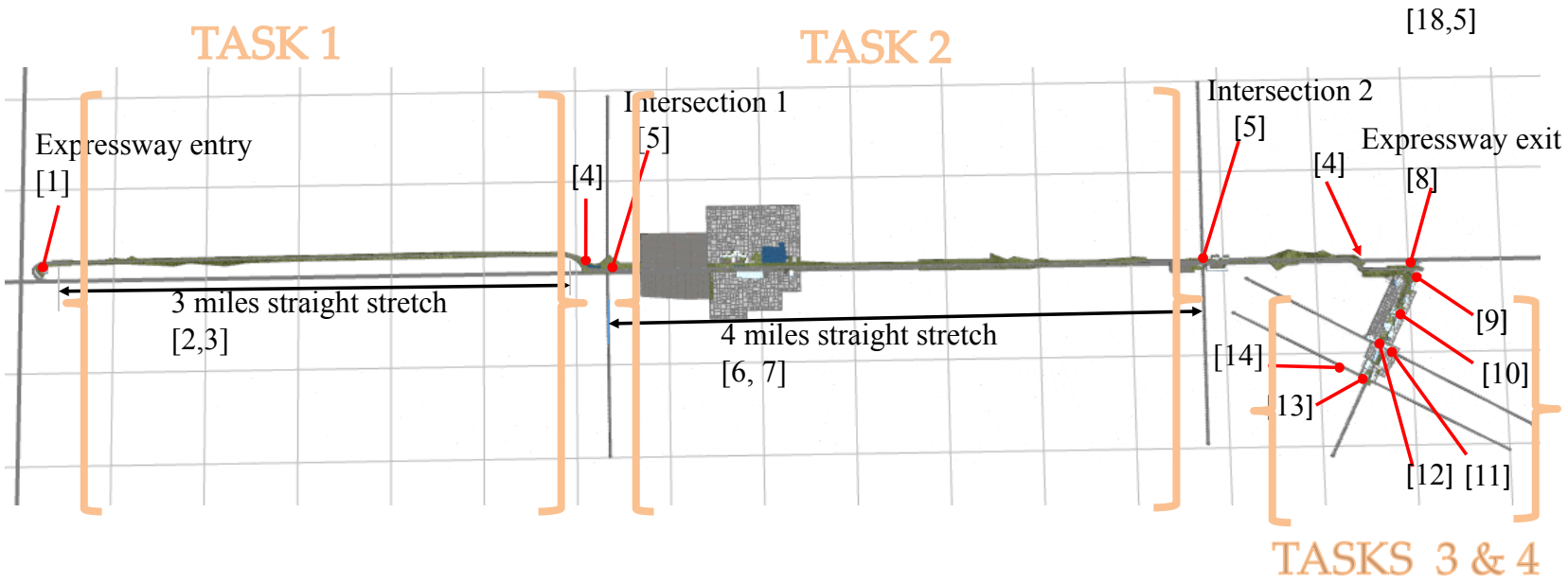
Pre-Study Phase: Collect Driving Style



Test Phase: Use Only Some of the Tasks



Masking the User's Own Style in Testing



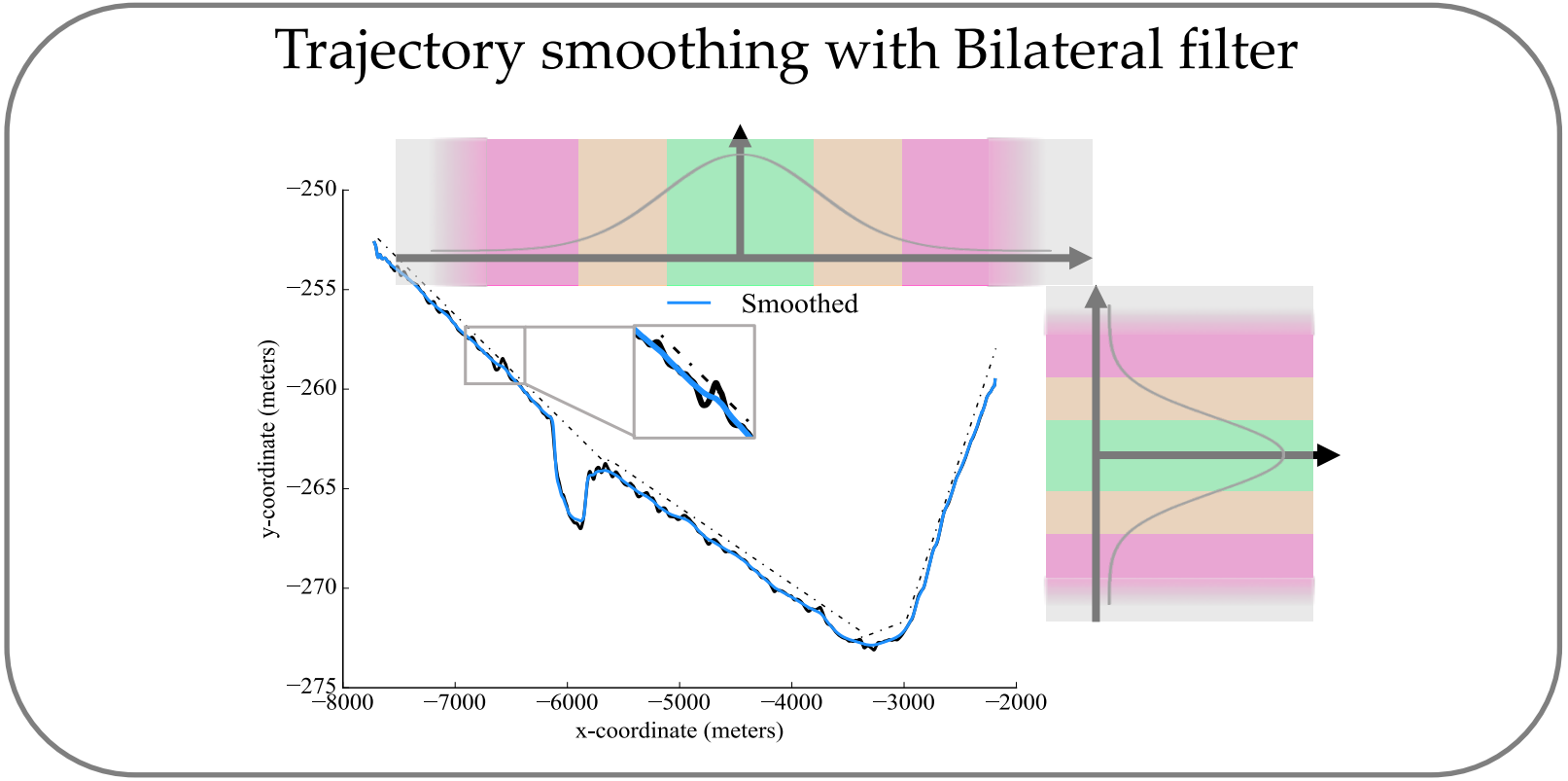
Masking the User's Own Style in Testing

Same route and traffic, different environment and traffic cars for different styles

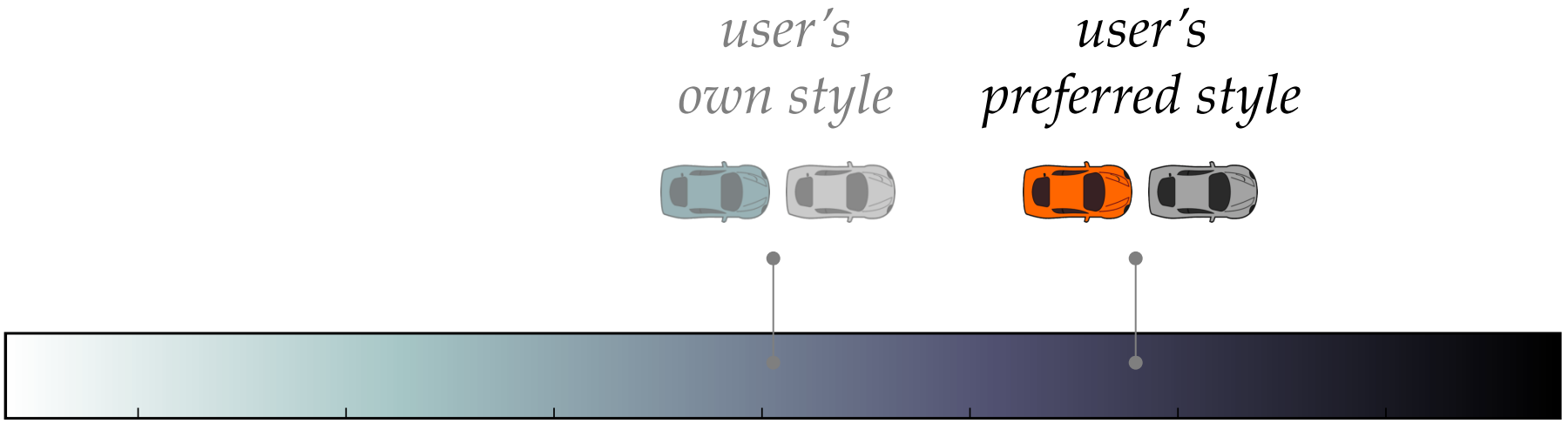
Masking the User's Own Style in Testing

- Randomize styles across tasks
- Tasks ordering different from manual mode

Masking the User's Own Style in Testing



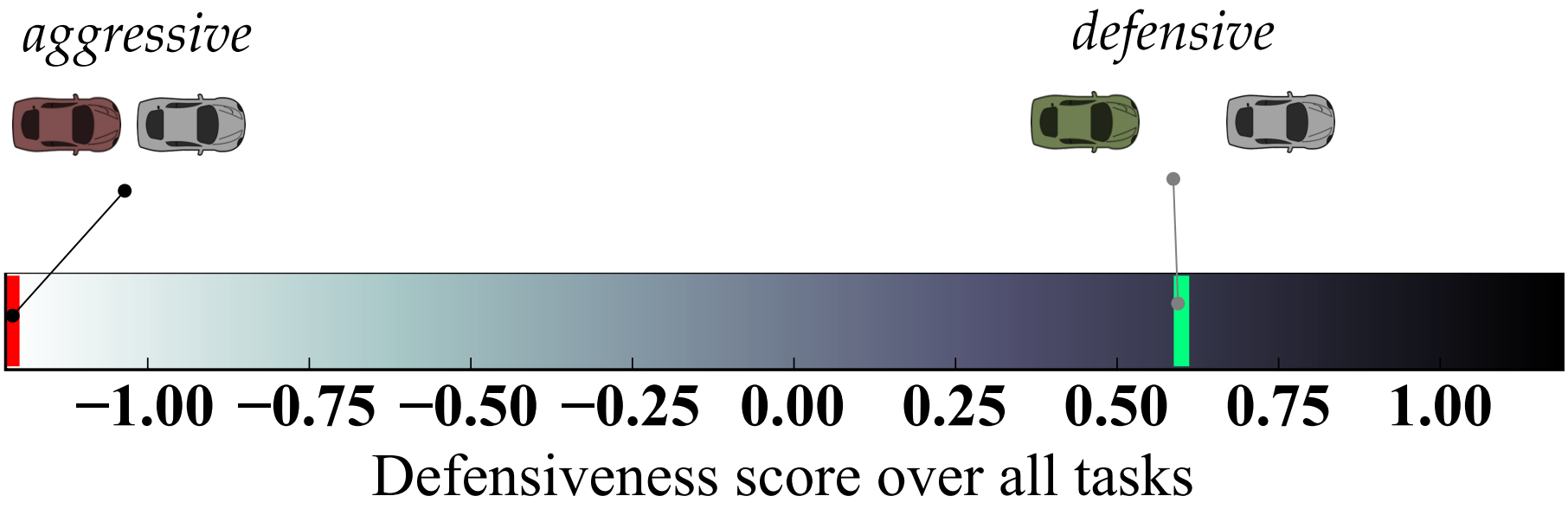
Hypothesis



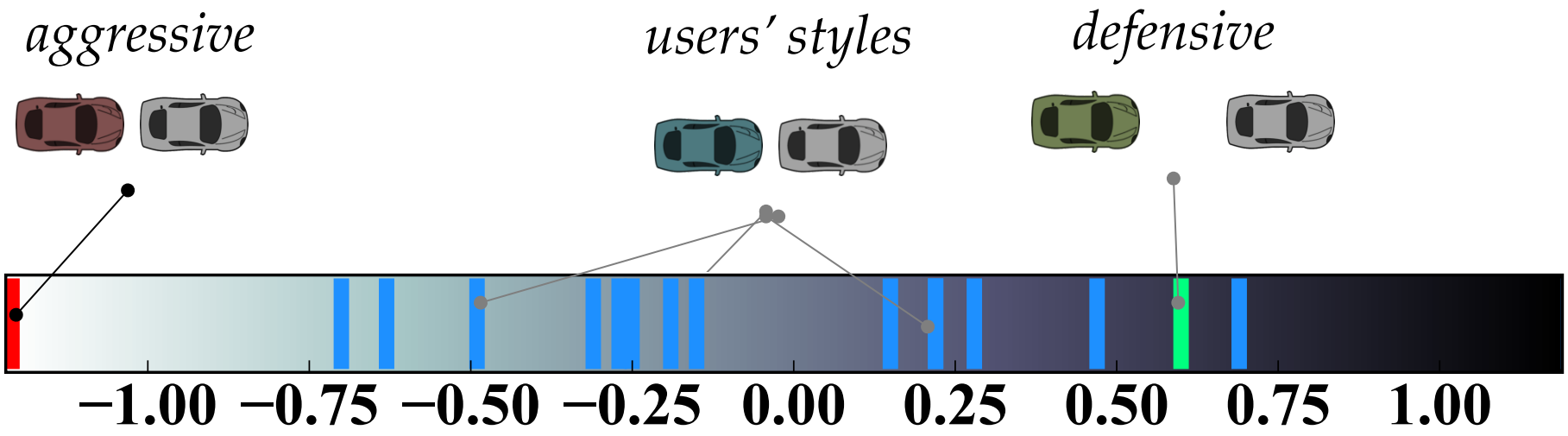
Study design

Results?

First, Manipulation Check!

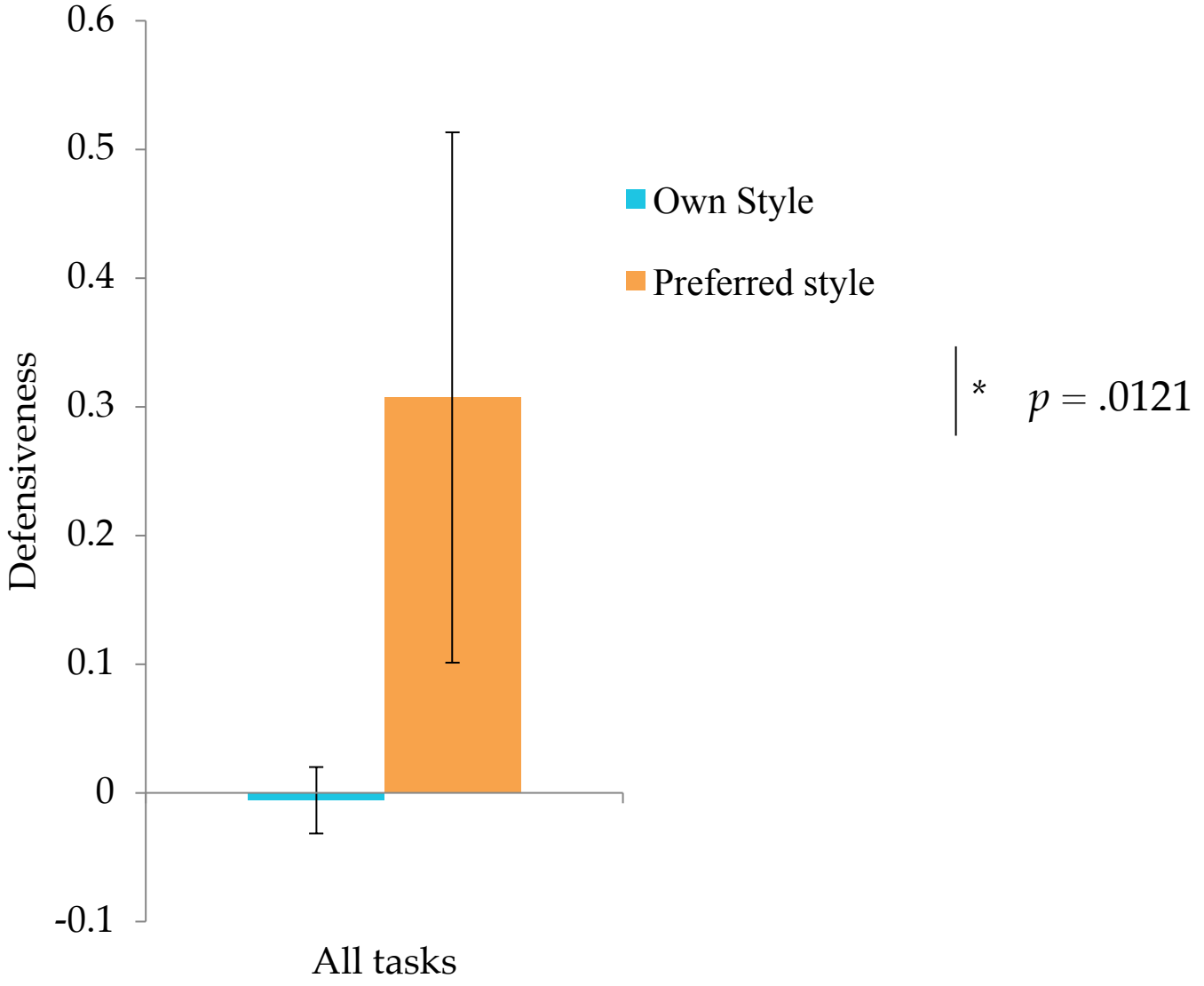


First, Manipulation Check!

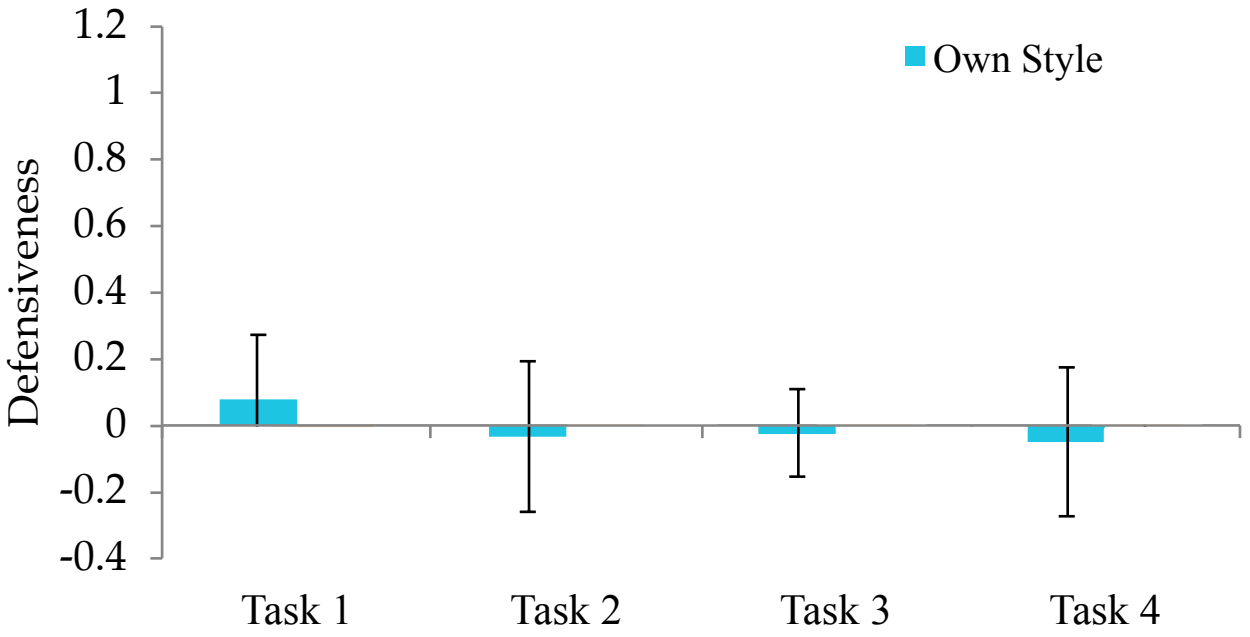


Most participants do lie between the aggressive and defensive styles.

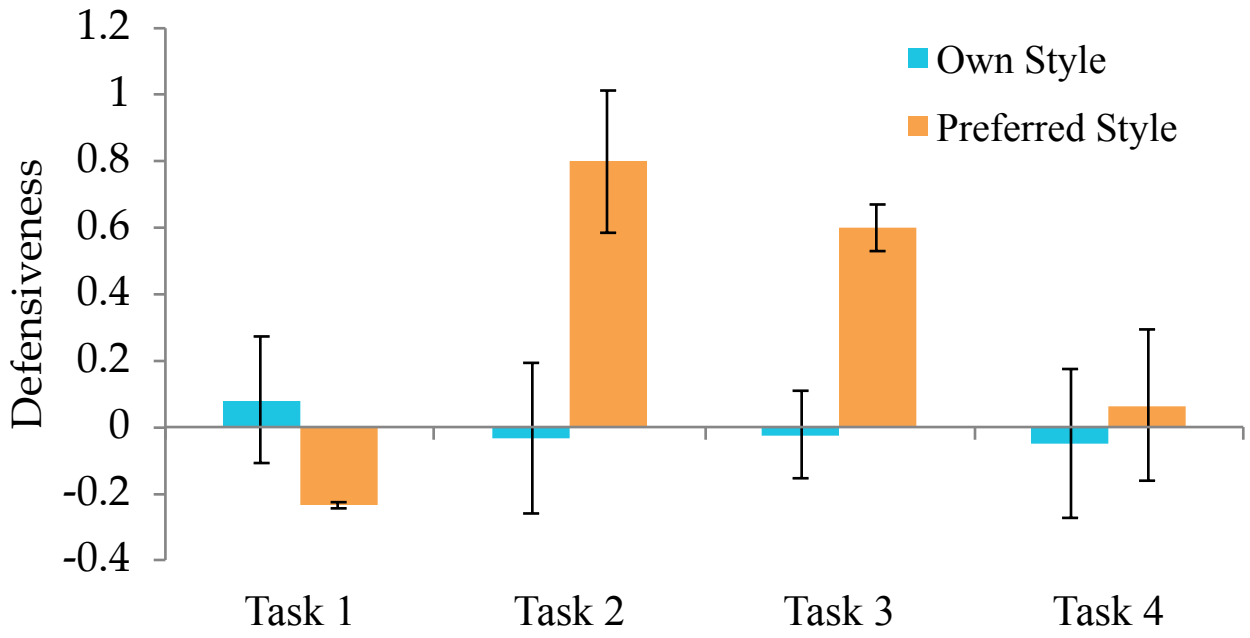
Own driving style vs. *preferred* driving style



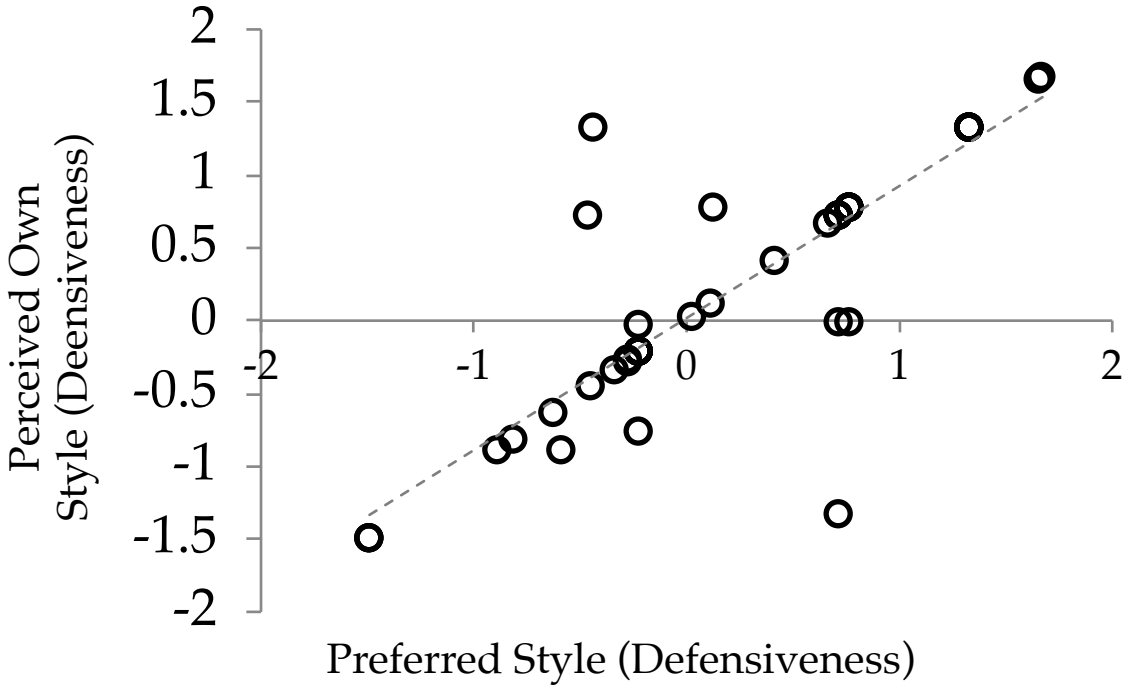
Own driving style vs. *preferred* driving style



Own driving style vs. *preferred* driving style

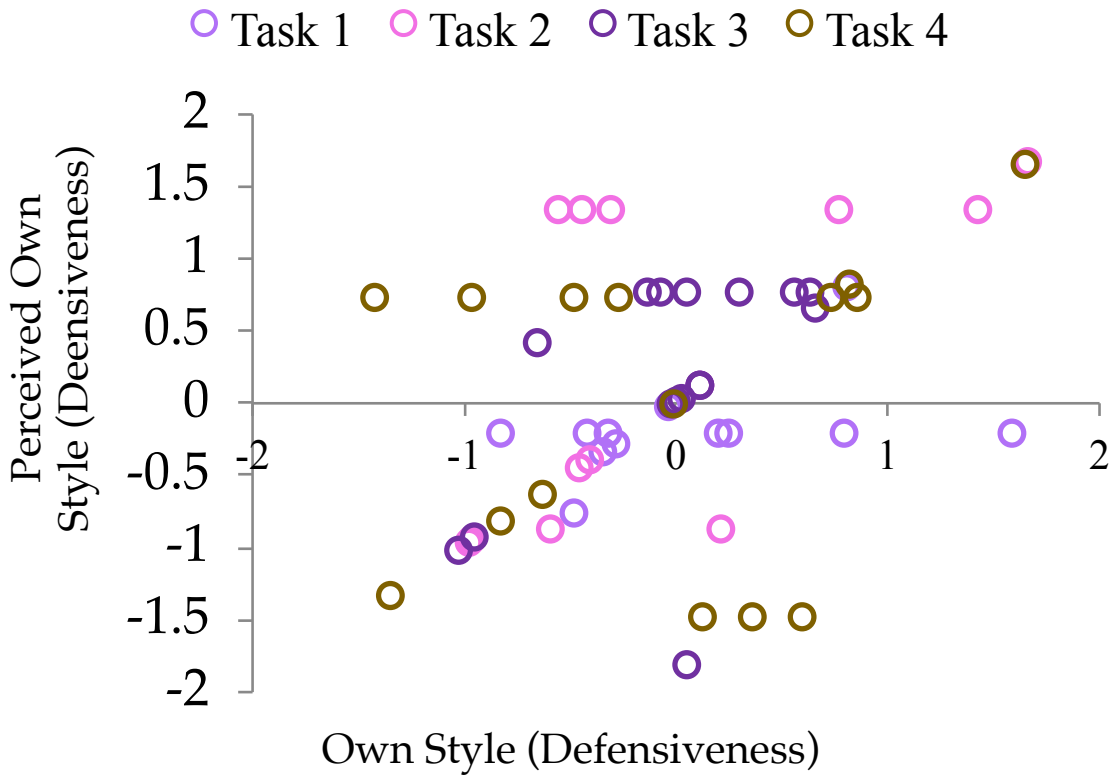


Perceived own style vs *preferred* driving style

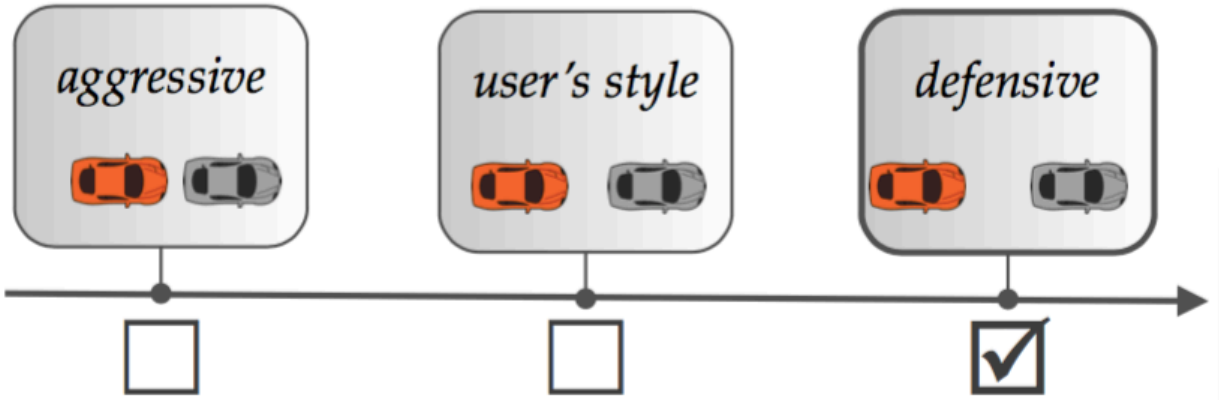


$r(58) = 0.86$

Perceived own style versus *actual* own style



46 % - 67 % participants could not identify their own style correctly!



Overall, people prefer a significantly more defensive driving style than their own.

Somewhat ironically,…

Users prefer the style that they think is their own, even if that style had little correlation with their real style.

With autonomous cars: we are all passengers, each with our own preferences.

How can we enable autonomous cars to match our these preferences?

Do you want your car to drive like you?

Chandrayee Basu
Qian Yang
David Hungerman
Mukesh Singhal
Anca Dragan