

What Makes a Driving Situation Complex?

An Additive Conjoint Approach to Visual Complexity in Vehicle Teleoperation

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Which characteristics of a driving situation make it more complex for remote operators?

We investigate scene-induced complexity for remote assistance with a choice-based conjoint approach based on real-world driving stimuli.

Video 1



Video 2

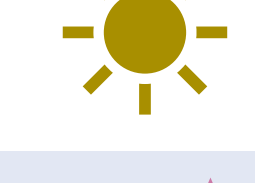


Background

Why does complexity matter?

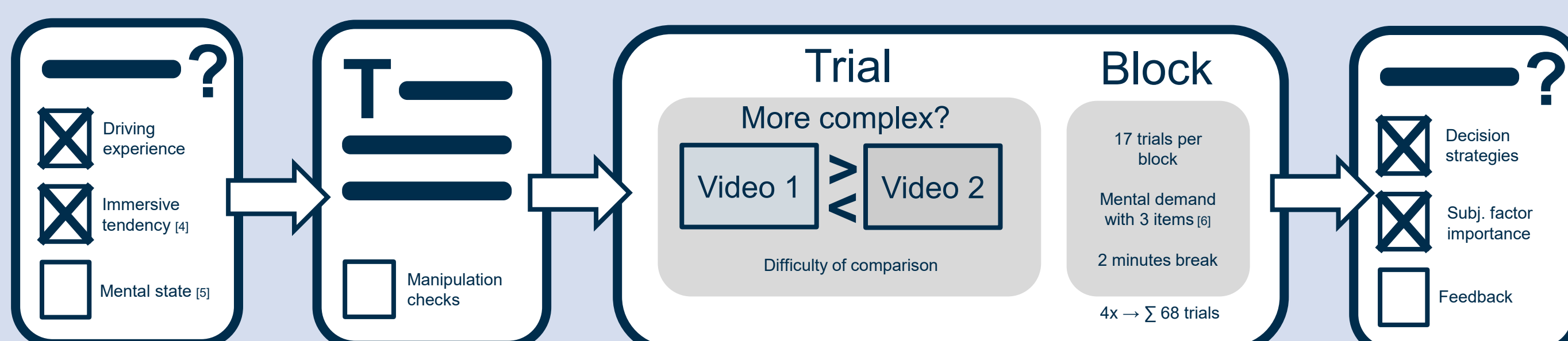
- Remote operators must rapidly build **situational awareness** from limited visual information [1]
- Scene characteristics** such as traffic density, visibility, and poorly recognizable traffic rules may increase these demands.
- Complexity contributes to **objective task demands** and is highly relevant for teleoperation as a socio-technical system. [1]

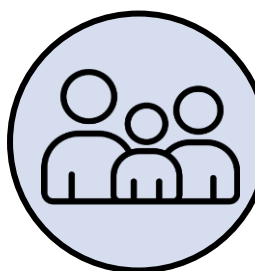
Which characteristics of a driving situation influence **perceived complexity in vehicle teleoperation**, and what is their relative contribution?

Factor		Low	Medium	High
 Relevant traffic participants		None to few (e.g., 2)	Several (e.g., 2 - 4)	Many (e.g., 5 - 7)
 Traffic density		Low traffic	Moderate traffic	Dense traffic
 Recognizability of traffic rules		Difficult, ambiguous	Partly recognizable	Clear, unambiguous
 Visibility		Night, poor	Dusk, transitional	Daylight, clear
 Type of situation		Straight road	Standard intersection	Complex traffic layout

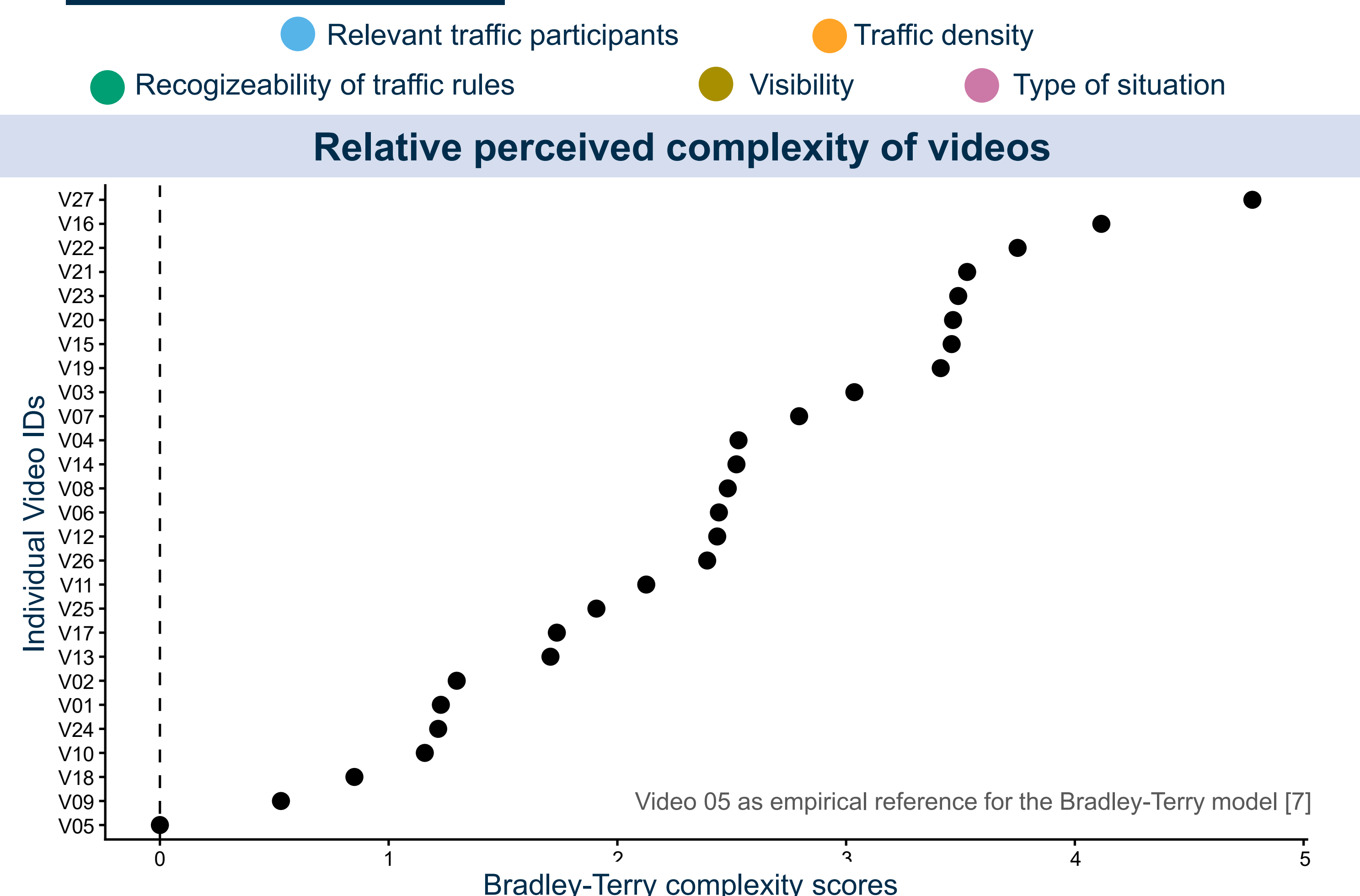
Methods

- $3^5 = 243$ scenarios → L27 orthogonal design each factor in each level 9 times, 3 times per factor pairs
- 27** driving scenarios + 2 training scenarios for pairwise comparison task in a **choice-based conjoint** approach [2]
- Real-world driving videos** collected with a **three-camera** setup

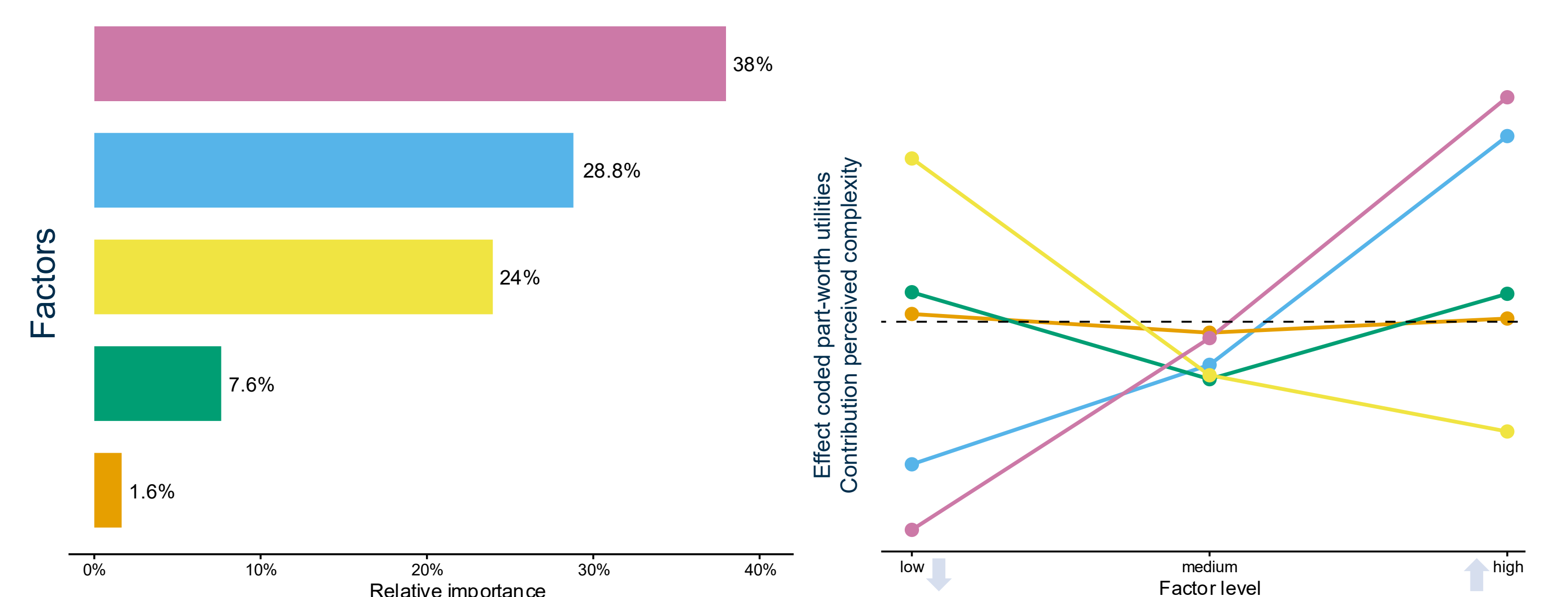


 $N = 28$ 12 ♀ 16 ♂ 82.1% students
 $M_{\text{age}} = 24.75$ $SD_{\text{age}} = 2.52$ Range: 21 to 29
 $M_{\text{ATI}} = 3.84$ $SD_{\text{ATI}} = 0.90$ $M_{\text{IT}} = 4.57$ $SD_{\text{IT}} = 0.67$
 Affinity for Technology Interaction Scale: 1 to 6 [3] Immersive Tendency Scale: 1 to 7 [4]

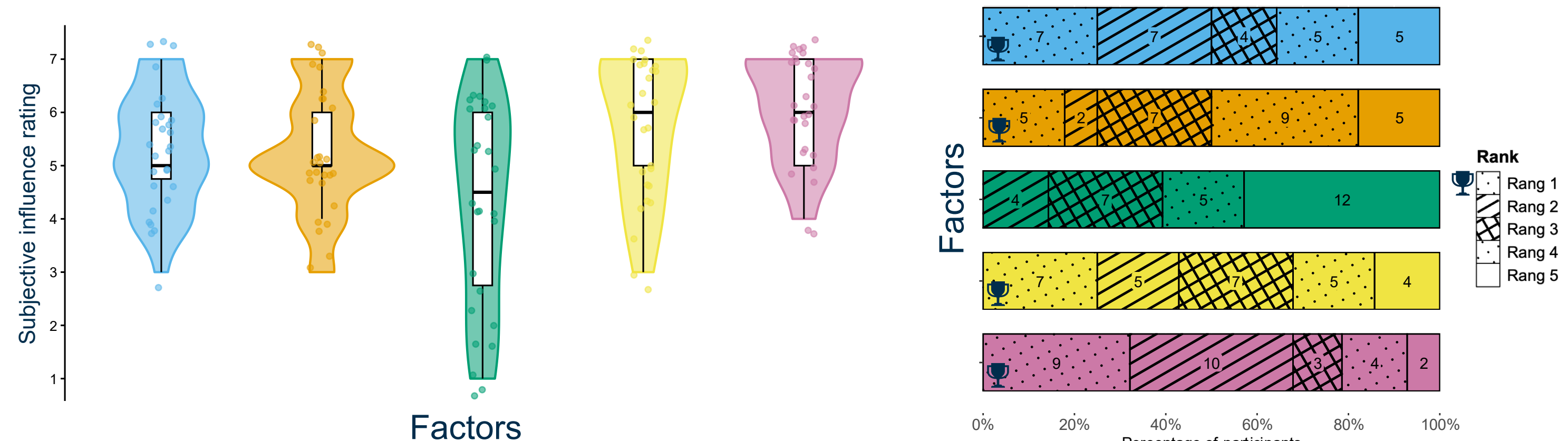
Results



Choice-based conjoint results



Additional subjective ratings



Outlook

- Larger sample to **stabilize effect estimates** and video rankings
- Refinement of **factor operationalization**
- Validate across **additional driving scenarios** to assess generalizability
- Include subjective relevance and conjoint results

