

Detection of Driving under Influence (DUI) of Alcohol: An Extended Review in Anticipation of Euro NCAP 2026

Jan-Philipp Göbel, Jan Cedric Mertens, Niklas Peuckmann, Andreas Riener | CARIAD SE, JKU, THI

Introduction

- **Impact of DUI on Road Accidents:**
 - DUI causes 25% of road deaths in the EU and 31% in the U.S. [1]
 - Legal BAC limit in the EU is 0.5‰, but 1.5-2% of road traffic is driven with illegal BAC. [2]
- **Driver Impairment and Accident Risk:**
 - Increasing BAC levels lead to higher driver impairment.
 - Exponentially higher risk of accidents with rising BAC. [3]
- **Vision for Safer Mobility:**
 - Euro NCAP 2026 aims to reduce damage caused by intoxicated drivers. [4]
 - Push for OEMs to implement Impairment Detection systems, including DUI.

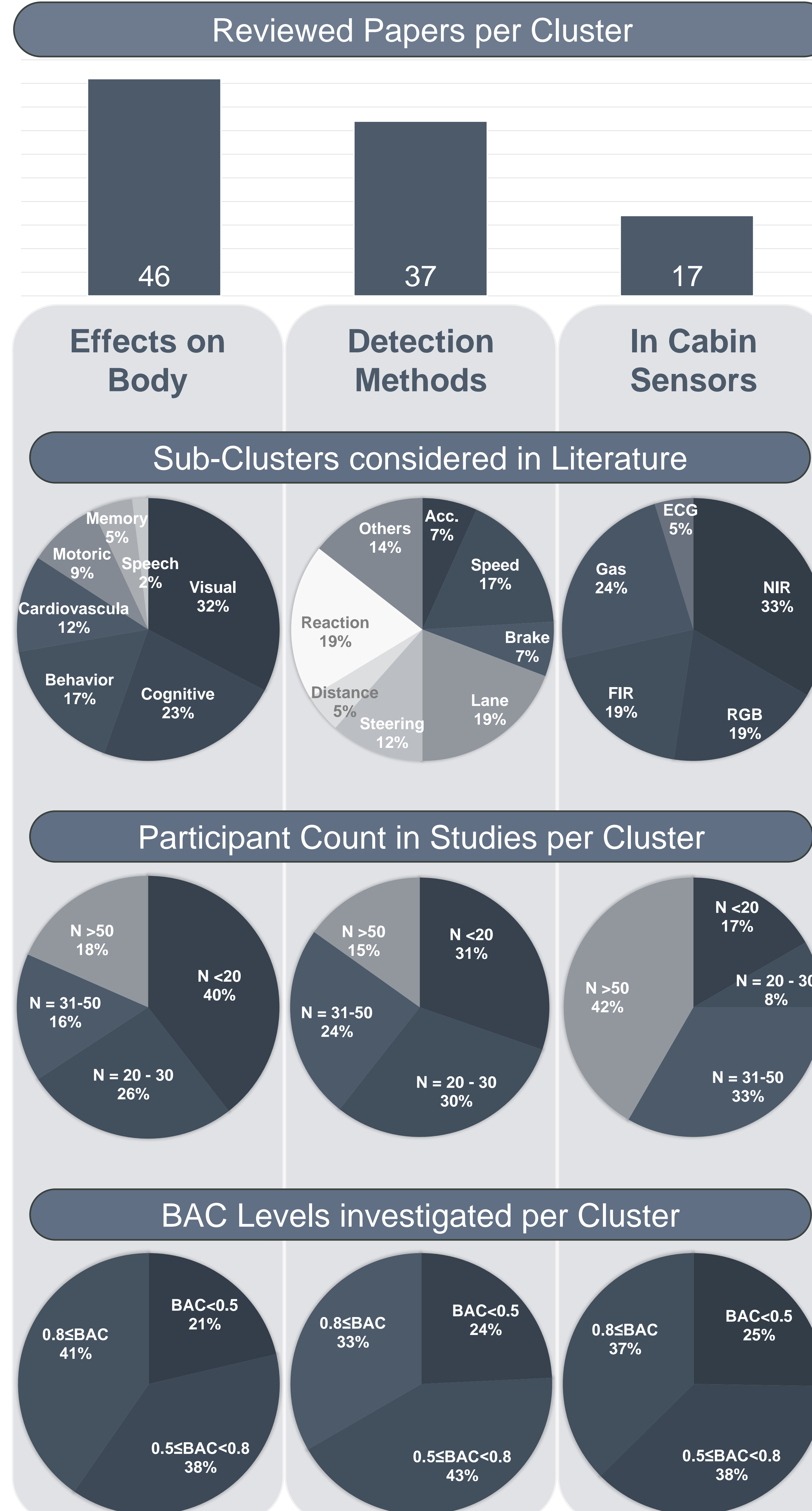
Objectives

- **Identify the Effects of Alcohol on the Body**
- **Identify and Summarize the Methods for DUI Detection**
 - Based on Driving Behavior
 - Based on Non-Invasive In-Cabin Sensors
- **Identify the Most-Analyzed Indicators**
- **Identify the Most Common Sensors for DUI Detection**
- **Identify Research Gaps in DUI Detection**

Methods

- **Research Focus Areas:**
 - Immediate effects of alcohol on the human body.
 - Methods for identifying intoxicated individuals through driving behavior and in-cabin sensors.
- **Databases Utilized:**
 - IEEE, Science Direct, PubMed, Google Scholar, and Google Search.
- **Research Methodology:**
 - **Step 1:** Conduct keyword searches and filter results by title and abstract.
 - **Step 2:** Apply snowballing and citation analysis, again filtering by title and abstract.
 - **Step 3:** Summarize and categorize the selected articles.

Results



Results

- **Total amount of Papers considered as relevant: 100**
 - Influence on Human Body: 46
 - Detection Methods (Driving Behavior): 37
 - Detection Methods (Sensors): 17
- **Key Insights:**
 - **Influence on Human Body:** Visual (22: eye movement, fixations, pupil dilation), Cognitive (15: performance, reaction time, hallucinations), Behavioral (11: attention, aggression, euphoria, fatigue, impulsiveness, social changes)
 - **Driving Behavior Changes:** Lane (21: lateral position variance), Speed (18: speed variance, average speed), Reaction Time (18), Steering (12: variance, velocity, performance), Acceleration (8)
 - **Non-Invasive DUI Detection:** Gaze (7: visual impairments, inattention), Gas Analysis (5: BAC in vehicle air), Face Observation (4: emotions), Temperature (3: cardiovascular effects)

Conclusions

- **Acute Impacts of Alcohol Intake:**
 - Impairments in visual perception, cognitive processing, and motor actions.
 - Increased aggressive behavior and changes in vital signs.
- **Driving Performance Degradation:**
 - Combination of impairments leads to measurable degradation in driving performance.
- **Key DUI Detection Metrics based on Driving Performance:**
 - Variance in lateral position and speed.
 - Increased acceleration and braking.
 - Slower reaction times.
- **Non-Invasive Sensor Detection:**
 - Use of NIR and FIR cameras to detect DUI indicators based on gaze and temperature.
- **Challenges and Outlook:**
 - Need for combining DUI indicators from driving behavior and in-cabin sensors.
 - High interpersonal differences make DUI detection challenging.
 - All possible indicators should be considered to meet NCAP 2026 standards.

References

- [1] Antonio Avenoso. (2019). Drink Driving in the EU: The fight against drink-driving and alcohol interlocks. https://etsc.eu/wp-content/uploads/02_Antonio-Avenoso.pdf
- [2] Blincoe, Larry (2023). The Economic and Societal Impact of Motor Vehicle Crashes, 2019 (Revised).
- [3] Blomberg, R.; Peck, R.C.; Moskowitz, H.; Burns, M.; Fiorentino, D. Crash risk of alcohol-involved driving: A case-control study, 2005. <https://doi.org/10.1016/j.jsr.2009.07.002>.
- [4] Euro NCAP (2022). Euro NCAP Vision 2030: a safer future for mobility. <https://cdn.euroncap.com/media/74468/euro-ncap-roadmap-vision-2030.pdf>