Proc. of the European Safety and Reliability Conference (ESREL 2026)
Edited by José C. Matos, Paulo B. Lourenço, Michael Beer, Daniel Oliveira,
Edoardo Patelli, Hélder S. Sousa, Rui A. Silva and Monica Santamaria
 Published by Research Publishing, Singapore.
doi: 10.3850/ESREL2026061419_esrel26-p26527-cd

Espoused Strategy versus Theory-in-Use in Young A1 Riders: Video and Eye-Tracking Evidence of Learning Gaps

Anders Brune Gjertsen

Nord University, Norway. E-mail: anders.b.gjertsen@nord.no

Jan Petter Wigum

Nord University, Norway. E-mail: jan.p.wigum@nord.no

Petter Helmersen Bogfjellmo

Nord University, Norway. E-mail: petter.h.bogfjellmo@nord.no

Simon Minsaas Bromstad

Nord University, Norway. E-mail: simon.m.bromstad@nord.no

Zymer Gela

Nord University, Norway. E-mail: zymer.gela@nord.no

Young riders of light motorcycles (A1) are exposed to a markedly higher crash risk than car drivers, with rates of serious injury and fatality reported to exceed those of car drivers by more than fiftyfold. Severe crashes involving this group are consistently associated with limited riding experience, inadequate speed adaptation, and insufficient hazard anticipation. Despite comprehensive formal training, young A1 riders remain disproportionately represented in both loss-of-control and interaction-related crashes. This study examines young motorcyclists stated strategies, their actual on-road behaviour and their own self-assessment after viewing themselves.

Eighteen A1 licence holders (16–18 years) participated in a mixed-method field study combining on-road riding with video-assisted interviews afterwards. Participants completed a ride along a given route wearing mobile eye-tracking glasses. Along this route four Areas of interests (AOIs) representing normal but demanding traffic contexts was selected for summative video analysis. This analysis focused on observable factors such as speed, positioning, riding line, technical handling of the motorbike, and behaviour in relation to hazards. Post-ride, semi-structured interviews were conducted, where each participant also viewed recordings of their own rides. After an interview analysis the results of the video analysis was compared to both the espoused strategies of the participants and their own reflections on their theory-in-use.

The findings show that young riders articulated curriculum-consistent strategies before riding and were satisfied with their own performance, while video analysis revealed a mismatch between their espoused strategies and their theory-in-use. Against this background, the research question was formulated as; How do discrepancies between young A1 riders' espoused theories and their theories-in-use illustrate limitations in their development of double-loop learning?

Keywords: Motorbike, youth, reflection, video, interview, espoused strategy, theory-in-use, double loop learning, wicked competence.

1. Introduction

The National Transport Plan 2022–2033 calls for renewed, targeted measures to reduce high-risk factors among vulnerable road users and highlights the need to revitalise work on motorcycle safety (Norwegian Ministry of Transport, 2021). Young riders of light motorcycles (A1) remain a pronounced high-risk group: rates of serious injury and fatality far exceed those of car drivers, and novice status, inadequate speed adaptation and limited hazard anticipation are repeatedly implicated in crashes (Høye, 2017; Høye et al., 2016; Iversen & Njå, 2022). National analyses further show a sizeable proportion of A1 accidents are run-of-road or interaction related and occur without extreme speeding or substance use, indicating shortcomings in routine riding decisions rather

than only gross risk-taking (Iversen & Njå, 2022; Norwegian Safety Investigation Authority, 2025).

Driver education in Norway is structured around the GDE framework and explicitly emphasises reflection as a core pedagogical aim (Peräaho et al., 2003; NPRA, 2026). Nevertheless, evidence suggests that declarative knowledge conveyed in formal training does not always translate into on-road preventive behaviour (Wigum et al., 2023; Sagberg, 2018). Concepts of espoused theory versus theory-in-use and single-loop versus double-loop learning help explain how curriculum aims may be received cognitively yet fail to alter tacit practised responses in complex, wicked traffic situations (Argyris & Schön, 1977, 1996; Schön, 1983; Goodlad, 1979).

This mixed-method study, commissioned by the Norwegian Public Roads Administration (NPRA) and carried out by Nord University in collaboration with SINTEF in 2025, combines instrumented on-road riding (mobile eye-tracking and video) with video-assisted semi-structured interviews of 18 A1 riders (16–18 years). By comparing riders' espoused strategies, observed behaviour across four demanding Areas of Interest (intersections, curves, and roundabouts) and their self-reflections when viewing their own rides, the study examines the cognitive mechanisms that underpin young riders' strategic self-assessment and the implications for teacher practice and curriculum design aimed at reducing novice crash risk.

2. Theoretical framework

All participants had, within the past two years, completed training to obtain a class A1 driving licence under the Norwegian training model. Norway has placed the Goals for Driver Education framework (GDE) (Vegdirektoratet 2016)(Peräaho, Keskinen, & Hatakka, 2003) at the centre of the education, and this framework constitutes a theoretical foundation for traffic education, conceptualising training from a hierarchical perspective. The framework comprises several hierarchical levels of behaviour and three columns addressing knowledge and skills, risk-increasing factors, and topics for self-assessment. The GDE matrix is grounded in psychological research and considers not only what drivers are capable of doing, but also what they are motivated and willing to do (Peräaho et.al, 2003).

To address all levels of the GDE framework, the Norwegian curriculum for all driving licence classes emphasises reflection as a core pedagogical tool (NPRA, 2026). Instruction is required to support the development of learners' reflective ability, which is explicitly included in learning objectives and relevant content throughout all stages of the training programme (NPRA, 2026). Learners are expected to reflect on their own actions and judgement tendencies, not only to know what is correct, but to be willing to act accordingly when driving independently. This aligns with Rismark et al. (2004), who highlight reflection, understanding, and attitudes as central goals of traffic education for promoting desired behaviour in traffic.

The Norwegian curriculum invokes Goodlad's five curriculum levels, ideological, formal, perceived, operational and experiential, and the notion of a hidden curriculum of norms, values and expectations reaching the learner as a byproduct of the training (NPRA, 2016; Goodlad, 1979). This hidden curriculum, embedded in the implemented and experienced levels, often shapes learners' interpretations and behaviours more strongly than teachers' explicit intentions, creating a gap from formal aims to lived experience that can affect how learners handle complex, value-laden situations (NPRA, 2026; Goodlad, 1979).

Traffic, and therefor driver education, ranges from relatively simple tasks to highly complex traffic situations in which technical control must be combined with continuous interpretation of the environment, the vehicle, risk analysis, and interaction with other road users. Argyris and Schön has two models for understanding how learning happens in these two different circumstances called single-loop and double-loop learning (Argyris & Schön, 1977;1996). The single-loop learning happens through trial and error and is good for a technical procedure like learning to brake. One could try the brake, reflect on what happens, and change the input to change the output. These problems are also coined *tame problems* by Schön (1983). But in the highly complex situations one encounters in traffic merely adjusting the "input" of the brake may be insufficient and therefor requires that the driver use double-loop learning and look at the underlying goals, challenges personal values and potentially reframes the problem itself (Argyris & Schön, 1977; 1996). These problems are called

wicked problems by Schön (1983), and lack clear boundaries or a single correct solution, it could involve multiple actors with differing interests, and proposed solutions to these problems could reshape the problem or even generate new challenges. And whilst the tame problems can be resolved through established procedures and rehearsed practical solutions, the wicked problems are not predefined but needs to be continuously constructed through action (Schön, 1983). To solve these problems, one must first frame the situation, and to address the situations Schön (1983) introduced reflection-in-action, whereby practitioners reflect while acting, adjust their behaviour, and learn in interaction with the situation. Action thus becomes not only a response, but also a form of exploration (Schön, 1983). In the Norwegian traffic education, this and other forms of reflection are utilised, and in collaboration with a "reflective practitioner" (Schön, 1983), represented by the driving teacher, this can function effectively. However, when learners transition to independent road users, this support is no longer present. Schön also points to time being an important factor, and that being able to handle these problems requires a lot of training (Schön, 1983). To enable learners to handle the wicked problems they will encounter, it's relevant to consider Knight and Page's (2007) concept of *wicked competences*, referring to the competence required to address such problems. This competence "… cannot be neatly pre-specified, take time to develop, and resist measurement-based approaches to assessment" (Knight & Page, 2007, p. 2). In a world of wicked problems, prescriptive rules and predefined routines for solving technical and tame challenges are therefore insufficient. Drivers require a form of wicked competence to be adequately prepared. Double-loop learning and the development of wicked competence are thus not only about doing things right, but about doing the right things. Suzen (2018) highlights a challenge in that the upper levels of the GDE matrix, and thereby aspects of wicked competences, are not assessed in the driving test, as they are process-oriented and difficult to measure within an assessment context (Suzen, 2018).

A key challenge related to double-loop learning, highlighted by Argyris (1982), is the distinction between espoused theory and theory-in-use. Espoused theory refers to what individuals claim they do, the values and principles they articulate, and the explanations they provide for their actions. In contrast, theory-in-use refers to the theory that actually governs behaviour; it is often tacit, unconscious, and may differ from what individuals claim to do. Argyris (1982) is explicit in arguing that people are rarely aware of the theory-in-use that guides their actions. Theory-in-use is frequently characterised by defensive routines that protect established values and problem framings, thereby inhibiting double-loop learning (Argyris, 1982). When encountering wicked problems, this may result in complex and value-laden situations being reduced to technical problems, despite an expressed intention to engage in reflection and learning.

The GDE framework is also designed to address wicked problems and support the development of wicked competences, and the Norwegian training model explicitly aims to extend over time to provide learners with extensive practice before they become independent drivers (NPRA, 2026). When considering class A1, this category faces challenges related both to the age and experience of licence candidates (minimum age of 16) and to Norwegian climatic conditions, where a cold, snowy and icy winter limits the riding season at both ends. This provides a limited foundation for developing the competence required to be well prepared for the wicked problems encountered in real traffic situations.

A study of 62 motorcycle riders indicates that substantial riding experience, including years of driving a car as well, does not necessarily translate into preventive riding behaviour (Wigum et al., 2023). Iversen and Njå (2022) report that 80% of riders involved in A1 accidents were categorised as novice or inexperienced. Høye (2017) and Høye et al. (2016) show motorcyclists are markedly more exposed than other road users, and a report from the Norwegian institute of transport economics indicates 27% of light motorcycle riders are involved in an accident within the first year after licensing (Sagberg, 2020). Although total light-motorcycle accidents rose by 24% and serious "Vision Zero" accidents by 18% in 2015–2020 compared with the previous six years, rates remain relatively stable when adjusted for increased vehicle registrations (Iversen & Njå, 2022).

Iversen and Njå (2022) also found that 80% of fatal A1 accidents were accidents occurring within system boundaries after

excluding extreme factors such as substance use and excessive speed. Because of this they recommend focusing more on riders' risk understanding (Iversen & Njå, 2022). This pattern aligns with research suggesting contemporary youth may be less sensation-seeking and more responsible than previous cohorts, yet face different contextual challenges (Arnett, 2015) (Suzen, 2018;2025). Suzen (2025) argues that engagement and responsibility should be calibrated to the present generation's values and modes of learning.

The Norwegian Safety Investigation Authority (2025) reports that their analysis of accidents show that strategies taught in training are not always implemented in practice.

3. Methods

3.1. *Participants*

The study included 18 participants aged between 16 and 18 years. Participants were recruited through social media and through driving schools that distributed an invitation on behalf of the research team. This recruitment approach resulted in a convenience sample. The sample consisted of 17 male participants and one female participant. The participants used their motorcycles both for transportation to and from various activities and for leisure riding. They reported riding experience ranging from approximately 2,000 to 12,000 kilometres over one to two riding seasons.

3.2 *Interview guide*

A semi-structured interview guide was developed based on key themes, including participants' experience, background, and general strategic choices in different traffic situations. Participants were also asked to reflect on their strategies related to the four areas of interests (AOIs) before viewing the riding footage and were subsequently asked to comment on what they observed in their own riding in relation to their espoused plans.

3.3 *Authors*

All authors of the article are involved in the education of driving teachers in Norway, with a particular focus on continuing professional development for motorcycle driving teachers and examiners (Nord Universitet, 2026). All authors have also worked as driving teachers, and two have additionally served as examiners for the practical riding test at the Norwegian Public Roads Administration.

3.4 *Analysis*

The analysis was done using a mixed-method approach, integrating systematic video analysis of riding behaviour with an interpretative analysis of interview data. Interview materials were analysed in direct relation to the video materials to examine first how their espoused strategies compared to actual observed theory-in-use, and secondly how they themselves reflected on their own observed practices.

The analytical approach for the interviews was informed by Braun and Clarke's (2006) thematic analysis and complemented by Eggebø's (2020) concept of collective qualitative analysis which offers a more explicit structure for more researchers to collaborate in the analytical process.

Video analysis combined manifest and latent analysis to focus mainly on the observable actions but also trying to interpret some underlying intentions and the decision-making processes (Holsti, 1966; Potter & Levine-Donnerstein, 1999). Interpretative analysis was conducted through working meetings where the material and emerging patterns were discussed and refined across the research team. Analytical claims were continuously scrutinised and required empirical substantiation, contributing to increased analytical transparency and credibility.

3.6 AOIs

There are four AOIs, and *AOI intersections* consists of AOI 1, 3 and 4. AOI 1 is a priority-road junction with a right turn into a sharp bend. AOI 3 is a T-junction onto a priority road with a restricted line of sight to the left, high approach speeds, an advance yield warning and a preceding left bend. AOI 4 comprises two consecutive two-lane roundabouts on a high-traffic approach with limited left-side visibility and nearby pedestrian crossings. These sites demand speed adaptation, clear positioning and broad visual sampling. AOI curves (AOI 2) consists of a sequence of variable-radius curves (60 km/h) taxing visual guidance, throttle control and line selection.

3.7 *Ethics*

The project was approved by Sikt: Norwegian Agency for Shared Services in Education and Research, and the data collection, storage and processing were conducted in accordance with General Data Protection Regulation (GDPR). All participants were given information about the objectives of the study, and potential risks in participating in it. Each participant gave written consent prior to data collection.

4. Results

4.1 Discrepancies between espoused strategy and actual practice

Before riding, participants articulated curriculum-consistent strategies emphasising speed adaptation, clear lane positioning to signal intentions, and long-range visual scanning - clearly reflecting recent formal training. However, video analysis revealed systematic deviations from these intentions.

At AOI intersections, riders frequently approached at excessive speeds relative to reference footage, often resulting in unnecessary stops due to limited observation time and creating uncertainty for other road users. Positioning was frequently ambiguous, with riders occupying the left wheel track or lane centre regardless of intended manoeuvre, and wide right turns involving corner-cutting from an initially leftward position. Such behaviour reduced predictability and increased situational risk.

In curves, behaviour varied: while some riders adhered to taught lines or prioritised sight distance, many positioned too close to the lane boundary on left bends, requiring mid-curve corrections when encountering oncoming traffic. Several riders drifted outward in sharper curves and performed abrupt speed adjustments, indicating entry speeds exceeding their ability to execute the intended line reliably.

Gaze data showed generally short and low fixation patterns. When following other vehicles, attention was often narrowly focused on the lead vehicle rather than the wider traffic environment. Only a minority exploited opportunities for anticipatory scanning, such as gaining an early overview when entering AOI 1. Blind-spot checks in roundabouts (AOI 4) were inconsistent and not systematically aligned with actual traffic conditions. In curves, most riders demonstrated an egocentric, near-field gaze directed at road surface features, while only a few adopted an allocentric gaze toward the vanishing point.

Deviations were also evident in technical handling. Many riders relied heavily on engine braking combined with compensatory throttle inputs, leading to unnecessary gear changes and disrupted braking sequences. Several failed to re-engage the gearbox until after exiting intersections, compromising smooth control during critical manoeuvres.

Taken together, these discrepancies across speed, positioning, gaze behaviour and technical sequencing indicate persistent difficulty translating espoused strategies into effective on-road practice. The findings highlight key areas where formal training does not reliably result in the development of intended tacit skills and provide the basis for the subsequent analysis of riders' awareness and recognition of these deviations.

4.2 *Limited ability to recognize one's own deviations*

After describing their strategies for each AOI, participants watched recordings of their rides and answered follow-up questions to identify gaps between espoused theory and theory-in-use.

Overall self-evaluations were positive: most participants judged their speed and positioning adequate, particularly at intersections, and believed their performance matched stated strategies. Some admitted to speeding in AOI curves, typically attributing this to confidence or route familiarity; a minority noted minor deviations in line choice and timing. After viewing footage, most remained satisfied with their visual scanning and gave general descriptions of gaze behaviour; only a few acknowledged specific shortcomings (e.g. neglecting blind-spot checks or not looking sufficiently to the right).

Reflections tended to stay at the level of general affirmation that actions had been "as planned", with justifications often serving to defend observed deviations rather than to analyse causes or consider alternative actions.

Notably, reflections differed by AOI type. At AOI intersections, participants seldom acknowledged errors such as high approach speeds or ambiguous lane positioning, and the

post-ride evaluations were brief and focused on structural factors (visibility, right of way, pedestrians). In contrast, reflections following AOI curves were more detailed, addressing driving line, timing and positioning and occasionally assessing risk from oncoming traffic. This pattern suggests participants perceive curves as technically dynamic and worthy of finer scrutiny, whereas junctions are treated as routine, standardised tasks.

In sum, video-assisted debriefs revealed limited critical self-appraisal: participants largely endorsed their espoused strategies despite observable deviations and offered few concrete plans for change, particularly in intersection contexts.

5. Discussion

5.1 *Discrepancies between espoused strategy and theory-in-use*

The findings reveal a significant gap between the strategies articulated by participants and their actual riding practices. This discrepancy aligns with the theoretical concept of espoused theory versus theory-in-use. When it comes to speed adaptation, positioning in intersections, choosing a riding line in curves, gaze, participants articulated strategies consistent with both rules and curriculum. However, the video data show that their actual behaviour often deviated from these strategies, with high speeds when approaching intersections, unclear positioning and riding line differing from curve to curve and so on.

This suggests that training effectively transmits declarative knowledge but does not consistently translate into the on-road practice of these participants. To some degree Goodlad's curriculum levels help explain this gap: the intended (formal) curriculum appears to have been received in the perceived and ideological layers, yet the implemented and experienced curriculum, shaped by subtler social cues, reward structures and situated habits, produced a different behavioural outcome. It could also be the case that the social norms have affected their behaviour, and that how other people drive have a stronger impact on these participants then what their driving teacher told them a year ago.

From a learning theory perspective, the predominance of single-loop learning during training could account for this pattern. Learners learn "what to do" and how to correct overt errors through repetition, but this may not foster the deeper reframing required to alter automatic practised responses in complex traffic contexts. The GDE framework (Peräaho et al., 2003) lets us now that learners must both know how to operate the vehicle and make choices both tactically and strategically but also have insights into their ability to make and follow these strategies. One could question how well these participants have developed the insights needed to start double-loop learning (Argyris & Schön, 1977; 1996). And seeing how they might have been affected by social norms after they've acquired their license, they should have a stronger inner mechanism that could help them see that it's not always safe or correct to do what others do.

The procedures and rules they learnt shows in the espoused theory, but as the findings are conclusive when it comes to observed behaviour compared to these espoused theories it might indicate that the procedures that they learnt haven't integrated sufficiently or created the wicked competences needed to perform in dynamically unfolding traffic situations (Knight & Page, 2007).

Even though the curriculum for rider training in Norway emphasises reflection as a tool, these findings could imply that current pedagogical outcome is declarative rules and schematised manoeuvres, and that it might need augmentation with approaches that to an even greater extent prompts learners to confront and revise their theory-in-use (Schön, 1983). If riders think what they are doing is correct, they will continue to do so. And since most riders think they are better than the average rider (Høye et al., 2024), it would be reasonable to say most riders think they are doing things correctly. Based on that, one could conclude that rider learners need help to be able to use double-loop learning to a greater extent.

Moreover, teacher practices contributing to the hidden curriculum (for example tacit approvals, normative cues about acceptable risk or lane use) should be scrutinised, since they likely sustain the gap between formal teaching and experienced behaviour.

5.2 *Limited ability to recognize one's own deviations*

As discussed, the results indicate a marked discrepancy between espoused strategies

and theories-in-use, while the video-based debrief further suggests a limited ability among participants to recognise their own deviations.

That participants were frequently satisfied with their performance despite objective deviations indicates a limited external-internal feedback loop: either feedback was insufficiently salient, or participants lacked the metacognitive strategies to translate visualised errors into revised procedural plans.

The satisfaction in their own performance could also to some degree be explained by Argyris' (1982) defensive routines that will defend the theory-in-use. The individual being questioned about their own performance might see the faults but will defend and rationalise them as part of this defensive routine. This refusal to perhaps analytically reframe the errors leads to single-loop learning (Argyris & Schön, 1977; 1996) and will to some degree limit the development of better strategies for the future. Defensive routines will prevent interrogation of underlying assumptions and therefor limit double-loop learning (Argyris & Schön, 1977; 1996).

If intersections and curves are addressed differently in rider training, this may help explain why participants showed clearer reflection in AOI curves than intersections. Teachers may be influenced both by the curriculum and by accident statistics emphasizing curve-related crashes, leading them to prioritise curves. And if intersections are treated as "tame problems" with predefined procedural solutions, learners may know what the solution *should be* without fully recognising their own actions. Curves, by contrast, may be handled as wicked problems (Schön, 1983) requiring exploration and discussion, supporting deeper reflection and double-loop learning.

6. Validity

This study uses a mixed-method design (video, mobile eye-tracking and video-assisted interviews) that strengthens internal validity through methodological triangulation: observable behaviour was directly compared with participants' espoused strategies and their post-ride reflections (Braun & Clarke, 2006; Holsti, 1966). Systematic video coding combined manifest and latent analysis and interpretative discussion across the research team increased analytical transparency and reduced individual bias (Eggebø, 2020).

However, external validity is constrained by the convenience sample (n=18), and the predominance of male participants (17/18), which reduce generalisability to broader rider population. Single-session debriefs limit inferences about longer-term learning or change. The guided route and predefined AOIs afford ecological relevance but do not capture the full variability of real-world exposures.

Ethical and data-security procedures were observed (SIKT approval; GDPR), supporting procedural validity.

7. Conclusion

This study demonstrates that young A1 riders routinely articulate curriculum-consistent espoused strategies yet enact systematically different theories-in-use when riding in demanding traffic contexts. Video and eye-tracking evidence revealed recurrent mismatches across speed adaptation, lane positioning, line selection, gaze behaviour and technical sequencing, while video-assisted debriefs showed participants largely failed to recognise or critically reappraise these deviations. Such patterns are indicative of predominant single-loop learning: learners can state correct rules and adjust discrete behaviours when prompted but lack the metacognitive routines and experiential grounding required to interrogate underlying assumptions and revise tacit practised responses when faced with wicked, dynamically unfolding traffic problems.

Accordingly, the discrepancies observed illustrate a clear limitation in the development of double-loop learning among novice A1 riders. Defensive routines, limited feedback salience and social influence and a hidden curriculum of normative driving behaviours appear to preserve existing problem framings and prevent learners from reframing goals, values and decision criteria that would produce safer on-road practice. The result is a gap between formal educational intent and experienced competence: declarative knowledge is present without robust, internalised wicked competence.

8. Implications

Given the findings and the empirical association between novice status and accident involvement in the A1 category, there is a compelling case to keep focusing on creating

salient, contextual feedback loops, and cultivating metacognitive reflection that challenges defensive routines, but also to a greater extent give repeated exposure to socially complex scenarios that cannot be reduced to single loop corrections. This could be done both by more practical training and more theoretical discussions suited for A1 riders. The training program could single out the "starter course" which is part of today's training, and make it separate for A1 and A2 & A, giving both the teacher and learners a better environment to challenge the learners to understand the need for, and develop wicked competence. Policy makers might also explore how to get rider learners to drive more with a reflective practioner before they start driving by themselves.

Future work should test findings in larger, more diverse and longitudinal samples, and evaluate structured interventions (e.g. repeated video debriefs) to establish external validity and causal impact on riding behaviour.

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