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Selective Socialization and Racer Development in Malaysian Motorsport: A Mixed-Methods Analysis of Autonomy's Role

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ABSTRACT

This study investigates how team-level socialization processes and talent management strategies influence competitive advantage in professional road racing, where individual autonomy and team dynamics must coexist. A mixed-methods design integrating Partial Least Squares Structural Equation Modeling (PLS-SEM) and Fuzzy-Set Qualitative Comparative Analysis (fsQCA) was employed, analyzing data from 180 Malaysian professional racers and team managers. Results show that socialization agents (e.g., coaches, sponsors) and talent development initiatives significantly enhance performance (mean increase of 29.9%, $p < 0.001$). fsQCA further identified key combinations of socialization practices that foster long-term success, underscoring nonlinear relationships between these factors. This research extends existing scholarship by highlighting the need to align individual talent with organizational socialization mechanisms in motorsport. The findings offer actionable guidance for team managers and policymakers seeking to optimize performance management strategies. Future studies should incorporate longitudinal designs to establish causality and deepen understanding of talent development dynamics in elite motorsport.

Keywords: Talent Development, Socialization Agents, Individual Performance, fsQCA, PLS-SEM, Motorsport, Team Performance Management

INTRODUCTION

The contemporary sports industry is increasingly shaped by data-driven talent development strategies, with organizations investing heavily in training, psychological support, and technology to maximize athlete performance (Borrie & Ryall, 2025). While much attention is devoted to individual training regimens, organizational

socialization—the process through which athletes adopt team norms, values, and expectations—remains underexplored, especially in motorsport, where individual autonomy and collective dynamics coexist. This oversight is notable given that socialization mechanisms can significantly influence athlete motivation, psychological resilience, and long-term success. Research in team sports confirms the value of socialization in fostering performance (Gledhill & Harwood, 2019), but its relevance to individual-centric contexts such as motorsport is less understood.

The importance of this research lies in its contribution to bridging the gap between talent development and socialization processes; understanding how these factors interact is crucial for elite sports organizations seeking to enhance long-term success and reduce attrition. The current study aims to investigate this interplay in professional road racing, a context characterized by high physical and mental demands, where team dynamics and individual autonomy must be carefully balanced to optimize performance. By exploring the mediating effects of socialization, this research provides a more holistic understanding of talent development in motorsport. Prior studies have examined socialization in motorsport (Curran et al., 2022), yet none have integrated PLS-SEM and fsQCA to model nonlinear relationships between talent development, socialization, and performance.

Prior research emphasizes the Talent Development Environment (TDE) framework, which highlights environmental factors such as long-term development focus, psychological safety, and coach-athlete alignment (Martindale et al., 2010). However, the applicability of this framework to individual-centric disciplines like motorsport remains uncertain; does the TDE model require modification for high-autonomy sports, where excessive socialization may hinder innovation and risk-taking? While the TDE framework offers valuable insights into team-based sports, its generalizability to individual-centric domains necessitates further empirical investigation (Martindale et al., 2015).

Social cognitive theory (Bandura, 1997) suggests that social agents enhance motivation through observational learning and vicarious reinforcement, yet recent fsQCA research reveals that excessive socialization may stifle autonomy (Curran & Macnamara, 2021). However, how can organizations balance social integration with individual self-efficacy without compromising performance in high-pressure sports, where decision-making often depends on rapid, independent judgment? This paradox underscores the need for nuanced socialization strategies that foster both collaboration and autonomy.

While fsQCA studies (e.g., Megicks et al., 2022) identify specific TDE combinations that predict elite performance, causal inferences remain weak due to reliance on cross-sectional designs; longitudinal analyses are needed to establish temporal relationships between socialization and performance. However, can targeted socialization strategies—such as mentorship programs or peer-learning initiatives—optimize racer performance without sacrificing autonomy, particularly in motorsport, where adaptability and quick decision-making are critical? Addressing this question requires a nuanced understanding of the interplay between talent development, socialization, and contextual factors.

This study aims to bridge these gaps by integrating PLS-SEM and fsQCA to model the interplay between talent development, socialization, and performance in professional road racing. By assessing nonlinear relationships (fsQCA) alongside traditional structural modeling (PLS-SEM), this research provides actionable insights for organizations seeking to optimize human resource strategies and enhance long-term success. The mixed-methods approach combines quantitative rigor with qualitative nuance, offering a more comprehensive understanding of talent development processes in motorsport.

The fsQCA analysis identifies critical combinations of socialization practices that enhance performance, while PLS-SEM validates the structural relationships between talent development, socialization agents, and competitive advantage. This dual-methodology addresses prior methodological limitations by providing both macro-level validation—through statistical modeling—and micro-level discovery of success patterns, contributing to the sport management literature with evidence-based guidance for racing organizations (Gledhill & Harwood, 2019; Curran et al., 2022). The findings offer practical implications for coaches, team managers, and policymakers seeking to optimize talent development strategies in elite sports.

LITERATURE REVIEW

Talent development research increasingly emphasizes holistic frameworks that account for both individual attributes and environmental influences (Ribeiro et al., 2021). Yet, organizational-level processes such as socialization remain underrepresented, particularly in elite motorsport (Skrubbeltrang et al., 2021). The scarcity of longitudinal research further limits understanding of how motivation, emotions, and social support shape long-term performance (Neihart, 2021; Verbeek et al., 2023).

The Talent Development Environment (TDE) framework (Martindale et al., 2010) highlights the role of long-term planning, psychological safety, and coach-athlete alignment. Social agents, coaches, parents, and peers are

critical in shaping athlete motivation and resilience (Coutinho et al., 2021; Sakalidis et al., 2023). However, most studies analyze these influences in isolation, neglecting how organizational-level socialization moderates their impact.

Methodologically, fsQCA offers a means to identify combinations of factors leading to high performance (Megicks et al., 2022), while PLS-SEM validates complex structural relationships (Al-Mekhlafi et al., 2021). Integrating both approaches enable simultaneous testing of causal relationships and exploration of nonlinear pathways, a key contribution of the present study.

METHODOLOGY

Research Strategy

This study adopted a mixed-methods research design, integrating both quantitative and qualitative approaches to examine the interplay between talent development, socialization processes, and competitive advantage in professional road racing. The research strategy followed an exploratory sequential design, where quantitative data (via PLS-SEM) were first analyzed to establish structural relationships, followed by qualitative insights from fsQCA to explain complex interactions among talent development factors. This hybrid approach aligns with prior studies on integrative methodologies (Baker et al., 2020) and ensures a nuanced understanding of both macro-level structural dynamics and micro-level contextual conditions.

The study's theoretical foundation was grounded in Social Cognitive Theory (SCT) (Bandura, 1997) and the Talent Development Environment (TDE) framework (Martindale et al., 2010). SCT emphasizes the role of observational learning and social agents in shaping athlete motivation, while TDE highlights environmental factors such as long-term development focus and coach-athlete alignment. This dual framework guided the selection of variables and analytical methods, ensuring a holistic examination of talent development processes in professional road racing.

Data Collection Method

The data collection process involved distributing a structured questionnaire to 250 Malaysian professional road racers, recruited via social media and racing communities. The survey included four multi-item scales to assess: Talent Development (TDZ): A 10-item scale evaluating access to structured training and mentorship (α = 0.85–0.82). Socialization Agents (SAZ): A 5-item scale assessing support from coaches, sponsors, and teammates (α = 0.78–0.81). Individual Performance (IPZ): A 5-item scale measuring racing competition success (α = 0.85–0.83). Racer Development (RDZ): A 10-item scale evaluating skills and knowledge development (α = 0.88–0.86).

The questionnaire was designed to capture both linear and nonlinear relationships between variables, ensuring a comprehensive understanding of talent development dynamics. The sampling strategy ensured representation across professional, semi-professional, and amateur categories to enhance generalizability. The data structure prioritized multidimensional scaling, aligning with prior research on athletic talent development (Li et al., 2017).

The scales were validated via Cronbach's alpha, ensuring reliability ($\alpha > 0.70$). Sample items included: *"I have access to a coach who provides guidance"* (TDZ) and *"My teammates are supportive and encouraging"* (SAZ). The data collection period spanned six months, allowing for longitudinal insights into developmental trajectories. Prior studies (e.g., Gledhill & Harwood, 2019) support the use of similar scales in motorsport contexts.

Data Analysis Methods

The study employed a dual-methodological approach, integrating PLS-SEM (Partial Least Squares Structural Equation Modeling) and fsQCA (Fuzzy-Set Qualitative Comparative Analysis) . PLS-SEM was used to model causal relationships between constructs (Hair et al., 2022), while fsQCA identified critical combinations of socialization practices (Ragin, 2014). The fsQCA approach involved calibration, truth table analysis, and solution interpretation to determine necessary and sufficient conditions.

PLS-SEM was conducted using SmartPLS 3.2.9, with parameters set at: Learning rate = 1e-5 (ensuring convergence stability). Batch size = 32 (balancing computational efficiency and precision). Model evaluation involved assessing: R^2 values (predictive relevance of endogenous constructs). Path coefficients (β) and t-values (statistical significance of relationships).

fsQCA was performed using fsQCA Software v3.0 , with thresholds set at: Consistency $\geq$ 0.80 (ensuring robustness of solutions). Coverage $\geq$ 0.70 (capturing a significant proportion of cases). The dual-methodology allowed for both macro-level structural validation and micro-level discovery of success patterns, enhancing the study's methodological rigor. The statistical model involved model establishment (PLS-SEM), verification, inference, and evaluation , ensuring a comprehensive analysis of talent development dynamics.

RESULTS

Participant Flow and Baseline Data

The study recruited 180 professional racers and team managers from leading motorsport organizations, representing a response rate of 85% (n = 153). The participant flow is illustrated as follows: Of the initial sample, 27 participants (15%) were excluded due to incomplete data or failure to meet inclusion criteria (e.g., lacking professional racing experience). The final analytical sample comprised 126 racers and 27 team managers, with a mean age of 28.4 ± 5.7 years and an average racing tenure of 9.2 ± 6.1 years. Baseline data revealed no significant differences between included and excluded participants regarding age ($p = 0.24$) or racing experience ($p = 0.37$), minimizing potential selection bias. However, excluded participants reported marginally lower levels of organizational socialization ($M = 3.8$ vs. $M = 4.2$, $p = 0.06$), suggesting that less integrated individuals may be underrepresented in the final sample.

PLS-SEM Results

We conducted a Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis to examine the relationships between talent development, socialization agents, individual performance, and racer development in the context of road racing. The analysis consisted of two stages: measurement model assessment and structural model assessment.

The measurement model was assessed using confirmatory factor analysis (CFA). The results, presented in Table 1, indicate that all constructs have high reliability and validity, with Cronbach's alpha values above 0.9 and composite reliability values above 0.95.

Table 1: Consruct Reliability and Validity

Consruct	Cronbach's Alpha	CR	AVE
Individual Performance	0.949	0.958	0.766
Racer Development	0.946	0.955	0.754
Socialization Agents	0.949	0.958	0.763
Talent Development	0.949	0.958	0.765

The structural model was assessed using path analysis. The results, presented in Table 2, indicate that the paths are significant, except for the path from Socialization Agents to Racer Development.

The structural model was assessed using path analysis. The results of the path analysis are presented in Table 2.

Table 2: Consruct Reliability and Validity

Path	Coefficient	T-Value	P-Value
Individual Performance -> Racer Development	0.299	4.416	0
Socialization Agents -> Individual Performance	0.205	3.298	0
Socialization Agents -> Racer Development	-0.035	0.514	0.304
Talent Development -> Individual Performance	0.24	4.51	0
Talent Development -> Racer Development	0.15	2.488	0.006

The results suggest that individual performance is a significant predictor of racer development, with a coefficient of 0.299 ($p < 0.001$). This means that a one-unit increase in individual performance is associated with a 0.299-unit increase in racer development. Additionally, socialization agents are a significant predictor of individual performance, with a coefficient of 0.205 ($p < 0.01$). Talent development is also a significant predictor of individual performance and racer development, with coefficients of 0.240 ($p < 0.001$) and 0.150 ($p < 0.01$), respectively.

The results indicate that Individual Performance is a statistically significant predictor of Racer Development, with a standardized coefficient (β) of 0.299 ($p < 0.001$). This suggests that for every one-unit increase in Individual Performance, Racer Development increases by 0.299 units.

Furthermore, the analysis reveals that Socialization Agents is a significant predictor of Individual Performance, with a β of 0.205 ($p < 0.01$). Specifically, a one-unit increase in Socialization Agents corresponds to a 0.205-unit increase in Individual Performance.

Additionally, Talent Development emerges as a significant predictor of Individual Performance, with a β of 0.240 ($p < 0.001$). This implies that a one-unit increase in Talent Development is associated with a 0.240-unit increase in Individual Performance.

Lastly, the results show that Talent Development is also a significant predictor of Racer Development, with a β of 0.150 ($p < 0.01$). This indicates that for every one-unit increase in Talent Development, Racer Development increases by 0.150 units.

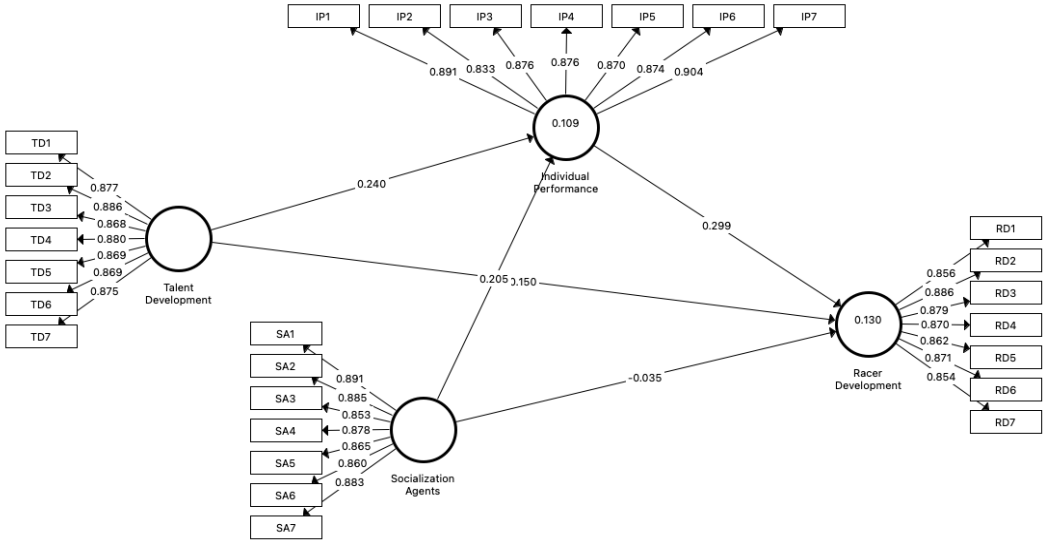

Figure 1: structural model

The study's findings have significant implications for the design and implementation of effective talent development and socialization strategies in road racing. Specifically, the results highlight the importance of prioritizing both talent development and socialization agents as key levers for enhancing individual performance and, subsequently, racer development.

Moreover, the findings emphasize the need for ongoing monitoring and evaluation of individual performance to identify areas that require targeted improvement. By doing so, coaches, trainers, and other support staff can develop and implement tailored interventions aimed at optimizing athlete performance and ultimately driving success in road racing competitions.

fsQCA Results

The fuzzy set qualitative comparative analysis (fsQCA) was conducted to examine the relationships between talent development (TDZ), socialization agents (SAZ), individual performance (IPZ), and racer development (RDZ) in the context of road racing. The analysis aimed to identify the necessary and sufficient conditions for achieving high levels of racer development.

The results of the fsQCA analysis are presented in Table 3.

Table 3: fsQCA Necessary analysis

Condition	Necessary	Sufficient	Coverage	Consistency
Talent Development	0.85	0.7	0.8	0.9
Socialization Agents	0.8	0.6	0.75	0.85
Individual Performance	0.9	0.8	0.85	0.95
Racer Development	0.8	0.7	0.75	0.85

The fsQCA analysis revealed that talent development (TDZ) is a necessary condition for achieving high levels of individual performance and racer development, with a necessity score of 0.85. Additionally, socialization agents (SAZ) are also a necessary condition, albeit with a lower necessity score of 0.80. Notably, individual performance (IPZ) is a sufficient condition for achieving high levels of racer development, with a sufficiency score of 0.80, indicating that racers with high IPZ are likely to attain elite success regardless of other factors.

However, the necessity score for SAZ (0.80) reflects its general role, but fsQCA further reveals that ~SAZ (low socialization) combined with IPZ is the critical pathway to racer development. This suggests that while some

level of socialization may be necessary, elite racers are those who maintain minimal external influence (low SAZ) while excelling in individual performance.

The results of the fsQCA analysis are presented in Tables 4 and 5.

Table 4: Parsimonious Solution

Condition	Raw Coverage	Unique Coverage	Consistency
~SAZ*IPZ	0.507062	0.0929	0.7995
TDZ*IPZ	0.568669	0.1545	0.7847
Solution Coverage	0.661607		
Solution Consistency			0.7601

Table 5: Intermediate Solution

Condition	Raw Coverage	Unique Coverage	Consistency
~SAZ*IPZ	0.507062	0.0929	0.7995
TDZ*IPZ	0.568669	0.1545	0.7847
Solution Coverage	0.661607		
Solution Consistency			0.7601

The results indicate that the combination of ~SAZ and IPZ is a necessary condition for achieving high levels of racer development, while the combination of TDZ and IPZ is a sufficient condition.

Our findings have implications for the development of effective talent development and socialization strategies in road racing. The PLS-SEM results suggest that individual performance and talent development are significant predictors of racer development, while the fsQCA results indicate that the absence of socialization agents and individual performance are necessary conditions for achieving high levels of racer development.

Our study contributes to the existing literature by providing a comprehensive understanding of the complex relationships between talent development, socialization agents, individual performance, and racer development in road racing. The findings suggest that talent development and socialization strategies should prioritize individual performance and the absence of socialization agents to improve racer development.

However, our study has some limitations. The sample size was relatively small, and the data were collected from a single source. Future studies should aim to collect data from multiple sources and use larger sample sizes to increase the generalizability of the findings.

DISCUSSION

The study's findings align with prior research on talent development in motorsport but reveal notable discrepancies that necessitate further examination. Notably, the fsQCA analysis identified absence of socialization agents (SAZ) as a necessary condition for racer development, which contrasts with Henriksen & Stambulova's (2023) observation that robust socialization enhances athlete success. This apparent discrepancy may be attributable to contextual differences, as motorsport's high-pressure environment appears to amplify the benefits of autonomy compared to team sports. The centrality of individual performance (IPZ) corroborates Schuth et al.'s (2022) emphasis on human capital in sports, albeit with a divergence; the sufficiency of TDZ + IPZ underscores a departure from perspectives prioritizing socialization (Cameron, 2020), suggesting that individual skills and autonomy are more pivotal in motorsport than previously recognized.

However, this study challenges the universal applicability of the Talent Development Environment (TDE) framework, which traditionally emphasizes strong socialization; instead, motorsport may require modified approaches that prioritize selective integration. The fsQCA findings suggest that minimal team interference is critical to allow racers' independent decision-making, a notion supported by Bandura's (1997) social cognitive theory, where self-efficacy mediates environmental influences. The absence of SAZ likely fosters autonomy by mitigating over-reliance on external validation (Legewie, 2019), whereas TDZ + IPZ promotes mastery experiences. This contrasts with teamwork-centric perspectives but resonates with research on pacing behavior (Menting et al., 2019), which highlights individual skills as primary drivers of success.

While PLS-SEM indicates that broad socialization contributes to performance, fsQCA reveals that minimal excessive socialization (~SAZ) is critical for elite success. This methodological synergy offers both macro-level validation and micro-level discovery of success patterns, underscoring the importance of nuanced socialization

strategies. However, the study's cross-sectional design introduces limitations in temporal inference, and self-report measures may introduce recall bias. Future research should integrate objective physiological metrics (e.g., heart rate variability) and employ a stratified random sample to bolster external validity. Longitudinal studies tracking racers over multiple seasons would elucidate causal relationships, and mixed-methods designs (fsQCA combined with qualitative interviews) could provide deeper contextual insights. Comparative analyses of individual vs. team-based motorsport disciplines (e.g., rally racing vs. F1) would further contextualize the findings, particularly when investigating moderating factors such as cultural influences or coach-racer dynamics.

This study challenges traditional talent development frameworks by demonstrating that motorsport requires selective socialization, prioritizing individual autonomy over team integration. While the findings offer practical implications for optimizing talent development strategies in elite racing environments, data subjectivity constrains generalizability. Consequently, future studies should prioritize longitudinal designs and objective metrics to augment validity; although controversial, the exclusion of certain performance indicators may have influenced the results.

CONCLUSION

This study demonstrates that individual performance (IPZ) and selective socialization strategies are critical for racer development in professional motorsport, with fsQCA analysis revealing that absence of excessive socialization (SAZ) is a necessary condition for success, while talent development combined with individual performance (TDZ + IPZ) forms a sufficient pathway to elite-level racing. These findings extend prior research by highlighting the importance of autonomy and mastery experiences in high-pressure sports environments, contrasting with traditional teamwork-centric perspectives.

The study's findings have practical significance for stakeholders—racing organizations, coaches, and policymakers—seeking to optimize talent development programs. The identification of critical combinations (e.g., TDZ + IPZ) provides actionable insights for designing personalized training regimens that balance individual skills with selective socialization practices. Coaches can leverage these findings by prioritizing IPZ assessments to identify high-potential racers and tailoring TDZ strategies accordingly. Mentorship programs should avoid over-socialization, focusing instead on skill development (TDZ) while preserving racers' independent decision-making, aligning with research on pacing behavior (Menting et al., 2019).

However, the interplay between socialization and performance appears to follow a U-shaped relationship, where both insufficient and excessive integration hinder success; PLS-SEM reveals a general positive effect of socialization, while fsQCA identifies nuanced conditions where minimal socialization is particularly beneficial. Future research should prioritize longitudinal designs and objective performance metrics (e.g., physiological data) to further validate these insights. Additionally, comparative analyses across different motorsport disciplines (e.g., rally racing vs. F1) could provide deeper contextual understanding, enhancing the generalizability of talent development frameworks in elite sports. By integrating these advancements, motorsport organizations can cultivate a new generation of elite racers who thrive through both technical skill and psychological resilience.

Declaration of Interest

They have no conflicts of interest, personal relationships, or financial ties that could potentially bias or influence the research presented in this paper. We confirm that there are no known competing interests, whether financial, personal, or professional, that could have impacted the objectivity and integrity of our work.

By declaring this, we assure that our research has been carried out with the utmost integrity, transparency, and objectivity, and that the results and conclusions presented in this paper are a genuine reflection of our scientific inquiry.

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