

Research article

Traffic as a social dilemma? Viewing road user behavior through a prosocial lens

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Traffic serves as a context where road users engage in various interactions, with the outcomes of these bearing significant implications for the safety of all involved. While traditional research on road user behavior has predominantly focused on risky behaviors, there has been an increasing emphasis on prosocial, or positive, behaviors. This paper posits that the road environment constitutes a complex social dilemma, wherein individual self-interest frequently conflicts with collective safety and efficiency. By integrating theoretical insights from literature on altruism and prosociality, including distinctions between altruistic (self-sacrificing) and mutualistic (mutually beneficial) behaviors, we advocate for a more profound conceptual understanding of prosociality within traffic contexts. Future research directions are explored, encompassing practical interventions, such as the implications for automated vehicle technologies. Ultimately, the paper proposes that enhanced theoretical clarity regarding prosocial driving can substantially contribute to the development of more effective policies and safer road environments.

1. Introduction

The road, which is often viewed merely as a physical space through which vehicles and goods are transported, is, in fact, a social environment. The interactions between road users, including drivers, cyclists, and pedestrians, create a complex social network that influences behaviors and safety outcomes (Markkula et al., 2020). Reframing road use recognises that road users are not isolated entities, but rather, they are participants in an interconnected social system. This perspective shifts the emphasis from individual actions to the interactions and reciprocal effects between road users, which can enhance comprehension of the motivational factors underpinning various behaviors. It therefore also aligns with the concept of social capital, whereby relationships between individuals in social groups can lead to cooperation and mutual support for the overall benefit of the

group (Putnam, 1993). We therefore aim to investigate the concept of prosocial road use, scrutinise existing research, identify forms for such behaviors, and explore potential future developments.

In doing so, we will build on existing theoretical and empirical research on the topic of prosociality. Therefore, as a starting point we must consider that, as with other social environments, the road presents a social dilemma between self-interested users. This means that there is a conflict between road user behavior that primarily benefits the public good and behavior that benefits the individual. An example of this would be in traffic merging scenarios, where if all road users merge in turn, then the traffic progresses smoothly. In this case, each user sacrifices a potential advanced position in the queue for the public good, however a self-interested road user can act selfishly and exploit this by

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advancing further up the queue to then merge, causing an overall delay for the line of traffic to accommodate this. This is an example of the classic tragedy of the commons, where public goods (where all benefit) are unstable and prone to exploitation by selfish actors. Much research has sought to understand how, when and why individuals behave prosocially (e.g. [Camerer, 2003](#); [Jensen, 2016](#); [Nowak, 2006](#)) in such scenarios to promote the public good, and we will explore these in relation to the road.

2. Current approach on prosociality in traffic

The traditional research focuses on traffic and transport psychology and road safety has predominantly centred on aberrant/risky behaviors, such as errors and violations ([De Winter & Dodou, 2010](#)). This is understandable given the significant consequences of these behaviors in terms of injury and crash involvement ([De Winter & Dodou, 2010](#)). However, recent studies (e.g., [Li et al., 2024](#)) are delving into prosocial driving behaviors, which contribute positively to a safer road environment.

Researchers have subsequently provided different definitions of road user behavior that benefit others. For example, by focusing on drivers, [Harris et al. \(2014\)](#) defined prosocial driver behavior as “a pattern of safe driving behaviors that potentially protect the well-being of passengers, other drivers, and pedestrians, and that promotes effective cooperation with others in the driving environment” (p. 2). In an earlier study, [Özkan & Lajunen \(2005\)](#) identified positive driver behaviors as behaviors with the intention “to take care of the traffic environment or other road users, to help and to be polite with or without safety concerns” (p. 357). In a more recent attempt, [Yilmaz & Öz \(2025\)](#) investigated the multidimensional nature of positive traffic behaviors and identified three factors: smooth and proactive mobility, environmentally sustainable behaviors, and risk communication. They defined the construct as “...secondary ‘unofficial/unwritten behavioral codes’ that

develop in a given context within the interaction of person, environment and climate, and vehicle. Positive driver behaviors are characterized by preventing the possibility of a crash via a proactive driving style, promoting smooth traffic flow, engaging in eco-friendly behaviors during driving, and communicating with other road users regarding risks in the traffic environment.” Critically, all of these behaviors share a commonality in that they enhance the experience of all road users. For instance, drivers who exhibit positive conduct engage in less aggressive behavior ([Özkan & Lajunen, 2005](#)). Moreover, greater prosocial behavior correlated negatively with crashes and traffic violations ([Harris et al., 2014](#)).

Numerous studies have also identified determinants of prosocial and positive conduct, particularly among drivers. For example, increased altruism was associated with prosocial driver behaviors ([Shen et al., 2018](#); [Yu et al., 2023](#)), such as yielding ([Yu et al., 2023](#)). Another dimension related to prosocial behaviors is the perceived traffic climate by road users ([Li et al., 2024](#); [Öztürk et al., 2024](#)). Research ([Li et al., 2024](#); [Öztürk et al., 2024](#)) has demonstrated that an individual’s perception of the traffic climate within their daily driving environment influences their propensity to exhibit prosocial or positive behaviors. This likely suggests a reciprocal relationship wherein individuals display prosocial or altruistic behaviors contingent upon contextual factors and the behaviors of other road users, which in turn shape the individual’s perception of the traffic climate.

This previous research however has certain limitations that restrict a comprehensive understanding within the context of transportation. Notably, the majority of these studies have focused predominantly on drivers ([Harris et al., 2014](#); [Özkan & Lajunen, 2005](#); [Kaye et al., 2022](#)) neglecting the significant value of prosocial behaviors in and towards other road user groups from their point of view. Although there has been research focusing on pedestrians ([Vandroux et al., 2022](#); [Öztürk & Öz, 2021](#)) and cyclists ([Useche et al., 2018](#)), these often only

adapt behavioral measurements originally developed for drivers (Reason et al., 1990; Özkan & Lajunen, 2005) to other groups and offer limited perspective from a single road user point of view. Viewing the road as a social environment therefore requires that all users are examined distinctly and equitably.

3. Towards a more integrated understanding of prosocial traffic behavior

We posit that while existing research is valid for investigating the frequency and determinants of prosocial behaviors, it tends to treat prosocial behaviors as a single, undifferentiated and proximate construct, failing to recognise the nuances between different types of prosocial actions. Therefore, it is lacking in terms of its conceptual understanding and application of the ultimate explanations of prosociality (Scott-Phillips et al., 2011), meaning future attempts to apply this research to actual traffic behavior are unlikely to be successful as they are limited to a narrow set of behaviors at an aggregate level, without thoroughly examining the interpersonal, motivational, and situational factors that influence these behaviors. This narrow focus overlooks the diverse range and origins of prosocial behaviors and the contexts in which they occur.

To address this, we believe that it is important to understand how individuals' prosocial traffic behavior vary systematically across two dimensions. These are the relative costs versus benefits incurred, and the underlying intentions. Consideration of these will illuminate how particular traffic behaviors can best be interpreted and understood. For example, it is essential to distinguish between mutualistic behaviors, where the actor also benefits, and altruistic behaviors, which incur a cost to the actor, to gain a more nuanced understanding of prosociality (Bowles & Gintis, 2011). However, studies on prosocial (Harris et al., 2014) or positive behaviors (Özkan & Lajunen, 2005) in road users have not adequately attended to nor addressed these distinctions with

regards to intentions. For example, in a recent study, Ge et al. (2025) demonstrated that time pressure influences the likelihood of prosocial behavior. Although the research did not distinguish the costs associated with these behaviors, it supports the notion that road users dynamically evaluate their environment and make intentional decisions. This has resulted in incomplete interpretations of prosocial behaviors across different road user contexts. Furthermore, Nandavar et al. (2019) states that, prosocial traffic behaviors may exhibit prosocial and helpful tendencies, yet they are not necessarily altruistic in nature. This might be because individuals may engage in these behaviors with the reward they anticipate receiving. They may not fully consider the cost and mutualistic benefits associated with such behaviors. For example, while factors identified by Yilmaz & Öz (2025) were classified based on their relevance to certain driver outcomes, the approach also did not identify the costs and benefits associated with these behaviors or their underlying origins. This is where a more integrated approach that directly addresses the underlying intentions and motivations would be key.

We therefore argue that there is a need to consider fully what prosociality means, in the context of road use. In order to do so, it will identify how the adaptive nature of prosociality (i.e. how the actor benefits from the costs they incur) can be applied to traffic behaviors. Highlighted below are selected examples, and how they can be applied to behavior on the road.

3.1 Reciprocity

This is a powerful force in explaining prosociality, consisting of two mechanisms; direct and indirect reciprocity. Direct reciprocity, originally termed reciprocal altruism (Trivers, 1971), incorporates all prosocial acts where the recipient and donor of the prosocial act exchange roles over a number of occasions, so that both benefit in the long-term despite incurring costs as part of these interactions. Alternatively, indirect

reciprocity (Nowak & Sigmund, 1998, 2005) works on the premise that the prosocial actor receives a reciprocated act from a third party rather than the direct benefactor. Typically applied to social living species such as humans (Romano et al., 2022) both rely on individuals being able to recognise, remember and continue to interact over a period of time. On the road such circumstances are unusual but do occur, for example in traffic conditions where road users are continually interacting (e.g. slow-moving traffic queues, regular journeys in and around workplaces, school runs). In those scenarios, costly but small reciprocal acts of prosociality can be beneficial (e.g. turn-taking, giving way, patience) for all road users so future research can explore how the mechanisms in reciprocity (such as recognition of prosocial acts, promoting the need for prosocial reputations) can be used to increase such acts.

3.2 Altruistic punishment

This behavior is directed towards individuals who do not engage in socially normative prosocial behaviors, whereby the former inflicts a cost (punishment) on the latter (Fehr & Gächter, 2002). This punishment is costly to perform (hence 'altruistic punishment'), but occurs even when the punisher and the punished will never interact again (Boyd et al., 2003; Fehr & Gächter, 2002). Such behavior can lead to increased prosocial behavior within a group, due to the desire of individual group members to avoid punishment, which in turn reduces the need for individuals to engage in such costly punishment. Examples of non-conformance to prosocial norms in traffic scenarios are all too common, so can the principles and mechanisms that make altruistic punishment successful in laboratories also be successful on the road? We believe so and provided it is safe and legal to do so, can be encouraged and promoted. It occurs occasionally now (such as leaving notes on poorly parked cars, where the costs incurred are from the time taken and small amount of resources to do this, and also from the potential social embarrassment/discomfort from doing this in

public) but could be more formally regulated in the future (such as public notices of repeat offenders of anti-social road behavior around communal areas such as schools), and future investigations can explore the efficacy of this.

3.3 Costly signalling

The costly nature of behaving prosocially can signal the underlying desirable qualities of the actor (Zahavi, 1995), suggesting the actor has the intention of benefitting from an enhanced reputation among observers of their prosocial act (Gintis et al., 2001). One such benefit can be enhanced desirability as a romantic partner (Bhagal et al., 2019), as prosocial individuals are preferred, particularly as long term partners (Farrelly, 2013). This intention and desire to appear prosocial can therefore be applied to the road, whereby road users can be motivated to behave prosocially with and towards other road users. This can be facilitated by specific interventions that promote this outcome of prosocial traffic behavior, and further research can examine this. Furthermore, sustainability will be a key facet of prosocial traffic behavior, and it has been shown that sustainable behavior can also act as a valued signal in mate choice (Borau et al., 2021; Farrelly & Bhagal, 2021; Palomo-Vélez et al., 2021). This suggests that promoting this outcome of sustainable traffic behavior and consumption may have positive effects overall.

3.4 Cross-cultural effects

In a manner akin to cross-cultural variations in aberrant road user behaviors (e.g., Useche et al., 2023; Vandroux et al., 2022; Wallén Warner et al., 2011), it is crucial to acknowledge similar differences in prosocial behaviors. Given the nature of these behaviors, they are likely to vary across cultures as the relative costs and benefits in different cultures themselves vary. By viewing the road as a prosocial environment, we should expect similar evidence of cross-cultural differences as found in other prosocial

behaviors (Henrich et al., 2005; Herrmann et al., 2008). For example, the strength of cultural norms of prosociality predict levels of altruistic punishment in experimental scenarios (Herrmann et al., 2008). In other words, in cultures with weaker norms of prosociality individuals will have a reduced intention to punish others, as the costs of such acts now outweigh any benefits, so the same should be expected in traffic scenarios. Additionally, the acceptability of these behaviors within the social context of traffic may also differ significantly. For instance, drivers may employ honking as a means of communication (Sung et al., 2019), which can be used to convey intentions, express gratitude, warn other road users, or even exhibit aggression. Another example is drivers flashing their lights to alert others about speed cameras or police presence, which might be perceived as altruistic behavior from the drivers' perspective. These behaviors may be more acceptable in collectivist cultures, whereas they might be less acceptable and considered unlawful in others, depending on the strength of cultural norms of prosociality (Herrmann et al., 2008). This cultural variation extends to the interpretation and enforcement of traffic laws, with certain behaviors being tolerated or even encouraged in some societies while being strictly prohibited in others. The influence of cultural norms on road user behavior is significant, and efforts to enhance road safety must consider these to develop effective, context-specific interventions.

3.5 The contribution of all users to the social environment of the road

Expanding the range of prosocial road user behaviors is crucial to gaining a more comprehensive understanding. For instance, studies reported positive correlations between the frequency of aberrant (Şimşekoğlu, 2015) or positive (Öztürk et al., 2024) behaviors exhibited by individuals as both drivers and pedestrians. Moreover, Xu et al. (2018) found that pedestrians who also drive exhibit fewer aberrant pedestrian behaviors compared to

those who do not drive. This underscores the importance of studying all road users' perspective distinctly and understanding the mechanisms behind these behaviors. However, it still does not address the distinction within prosocial behavior and whether road users exhibit similar patterns of behavior regardless of the cost of different forms of road use (which may be higher for vulnerable road users). This understanding could enable the development of targeted campaigns aimed at promoting a positive traffic safety culture across all user groups by cooperating prosocial/positive road users into the context, ultimately contributing to safer and more cooperative road environments.

3.6 Future applications

This proposed conceptual approach to prosociality is crucial not only for understanding current interactions among road users but also has direct implications for contemporary road safety interventions and for the future of mobility systems. A growing body of evidence suggests that promoting prosocial driving behaviors can yield tangible safety benefits. For instance, recent work by Lewis et al. (2025) demonstrates that messaging interventions designed to encourage prosociality (e.g., consideration for other road users) can influence driving practices in ways directly linked to safety-relevant outcomes. Such findings align with the broader theoretical proposition that prosocial orientations may act as a counterbalance to purely self-interested decision-making in traffic, thereby mitigating behaviors that elevate crash risk. Consequently, advancing our understanding of prosociality is not only conceptually valuable but also provides a practically actionable pathway for improving road safety outcomes and traffic culture in the current transport system, complementing traditional approaches that focus primarily on deterring violations and risky behaviors.

In parallel, this perspective has clear implications for the design and integration

of automated driving systems (e.g., Cleij et al., 2025; Haué & Merlhiot, 2024; Sahin Ippoliti et al., 2023). A substantial body of literature examines how automated vehicles should be designed to behave and negotiate interactions with other road users, including human drivers and vulnerable users such as pedestrians and cyclists (e.g., Haué & Merlhiot, 2024; Liu, 2024; Sahin Ippoliti et al., 2023). This emphasis on driving style within the design of such vehicles is particularly important as it influences their acceptance within the traffic system and also traffic and fuel efficiency. Sahin Ippoliti et al. (2023) demonstrated that external displays can be employed to encourage prosocial behaviors. Moreover, prosocial behaviors, identified as yielding, are context-dependent (Sahin Ippoliti et al., 2023), for example yielding to a single vehicle is not equivalent to yielding to multiple vehicles. This has implications for both safety and efficiency within the traffic system. From our perspective, it is essential to fully understand prosociality in automated vehicles, and guide future research. For example, it would be valuable to explore how drivers respond to the prosocial features of automated vehicles, and how communication of the value of such behaviors (e.g. highlighting the safety benefit to all drivers from individual acts) can influence peoples' attitudes towards such vehicles.

As such, defining what constitutes “good” or desirable driving behavior remains a key challenge. As articulated by Quante et al. (2024), the successful integration of automated vehicles is contingent upon their capacity to cooperate with other road users and the collection of data through traffic observations and experiments, which include online platforms, laboratory settings, test tracks, and simulators are important to achieve this. These studies are crucial for conceptualising the cooperation and interaction among road users, identifying elements that contribute to final outcomes, and defining the behaviors of automated driving systems. While it is expected that automated vehicles will

not exhibit unsafe or aberrant behaviors, the extent to which prosocial acts are valued, implemented to their behavioral modelling, and how the system determines the appropriateness of certain behaviors in specific situations, remains a future research avenue. The dilemmas addressed by Cleij et al. (2025) regarding the decision-making processes of automated vehicles, such as the benefits for the vehicle itself versus the traffic system, or safety versus efficiency, may become more deterministic in the context of automated vehicles.

Crucially, there is a clear relationship between prosocial and sustainable traffic behavior, and this should serve as a clear direction for future research. There is a focus understand pro-environmental behaviors and attitudes in different domains (e.g. Lange, 2024; Milfont & Duckitt, 2010; Vlasceanu et al., 2024; Wyss et al., 2022). It should not however be expected that sustainable behaviors in one domain (e.g. water usage) will be affected by interventions aimed at another (e.g. recycling), showing that sustainability is multi-dimensional (Lange, 2024; Larson et al., 2015). This may be especially true of sustainable traffic behavior, as this could be an unfortunate anomaly (Walker et al., 2023). Framing sustainable traffic behavior as prosocial may facilitate how the content in this paper can be applied to increase it, something particularly pertinent as we enter the United Nation's ‘Decade of Sustainable Transport’ in 2026 (United Nations, 2026).

From an applied perspective, interventions (e.g., Knobel et al., 2013; Scott-Sharoni et al., 2024) may promote prosocial behaviors, thereby enhancing the well-being of all road users (e.g., Kim et al., 2024). Connected and automated vehicle technologies, along with other technological interventions, can have the potential to facilitate real-time communication between vehicles, thereby promoting cooperation and awareness among road users to facilitate safe interventions. In conjunction with intelligent traffic systems, these technologies can optimise traffic flow,

reduce congestion, and potentially enhance prosocial behaviors, or create a traffic system that encourages more prosocial and safer behavior among road users. Furthermore, the integration of gamification elements into vehicle interfaces or mobile applications can incentivise and reinforce positive driving habits. For example, research could explore how recording and quantifying an individual drivers' prosocial traffic acts (e.g. yielding, safe overtaking of cyclists) may affect their subsequent behavior, particularly if these can be publicly broadcast. It would be predicted here that, based on costly signalling (section 3.3), that it will lead to increased prosocial behaviors. When meticulously implemented, these technological solutions, based on a more in-depth and integrated understanding of prosociality, possess the capacity to foster a more cooperative and safer driving environment, ultimately contributing to enhanced road safety and social cohesion among road users. Furthermore, the deeper appreciation of prosociality in relation to road users outlined above can also contribute to the development of such interventions.

4. Conclusion

We have explored the concept of prosociality in traffic environments, highlighting the need for a more comprehensive and nuanced understanding of these behaviors. Although this study is not without limitations, given its focus on literature discussion and commentary, future empirical research is necessary to investigate the proposed directions and further elucidate the interactions between road users from a prosociality standpoint. By framing road use as a complex social dilemma, we have emphasised the importance of considering the different forms and origins of prosocial behaviors in traffic contexts. It has identified several key areas for future research, including the applications to road user behavior. We have also highlighted the importance of considering cross-cultural differences in prosocial traffic behaviors as well as all road users in our understanding of the social environment of the road. The

paper has discussed potential applications of this enhanced understanding, particularly in the context of automated vehicle design and integration. Future research directions should focus on developing more comprehensive conceptualisations and measures of prosocial road use across road users, exploring interventions to promote road safety, and utilising advanced technologies such as simulations and virtual reality to test these concepts.

CRediT contribution

İbrahim Öztürk: Conceptualization, Investigation, Visualization, Writing – original draft, Writing – review & editing. **Daniel Farrelly:** Conceptualization, Investigation, Visualization, Writing – original draft, Writing – review & editing.

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The authors report no competing interests.

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The authors declare that no generative AI was used in this work.

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