A theoretical perspective on road safety communication campaigns

ABSTRACT

This paper proposes a theoretical perspective on road safety communication campaigns, which may help in identifying the conditions under which such campaigns can be effective. The paper proposes that, from a theoretical point of view, it is reasonable to assume that road user behaviour is, by and large, subjectively rational. This means that road users are assumed to behave the way they think is best. If this assumption is accepted, the best theoretical prediction is that road safety campaigns consisting of persuasive messages only will have no effect on road user behaviour and accordingly no effect on accidents. This theoretical prediction is not supported by meta-analyses of studies that have evaluated the effects of road safety communication campaigns. These analyses conclude that, on the average, such campaigns are associated with an accident reduction. The paper discusses whether this finding can be explained theoretically. The discussion relies on the distinction made by many modern theorists between bounded and perfect rationality. Road user behaviour is characterised by bounded rationality. Hence, if road users can gain

insight into the bounds of their rationality, so that they see advantages to themselves of changing behaviour, they are likely to do so. It is, however, largely unknown whether such a mechanism explains why some road safety communication campaigns have been found to be more effective than others.

1 INTRODUCTION

It is rarely the case that studies evaluating the effects of road safety measures are based on well-founded theoretical predictions of those effects (Elvik 2004). An important reason why theoretical prediction of the effects of road safety measures is difficult, is the fact that many road safety measures are associated with behavioural adaptations among road users, the nature and intensity of which cannot usually be predicted very precisely (Rudin-Brown and Jamson 2013). Indeed, some forms of behavioural adaptation, like changes in alertness, are virtually impossible to observe (Young and Regan 2013).

How about road safety measures that are intended to influence road user behaviour, in particular communication campaigns designed to motivate or persuade road users to adopt safer behaviour? Can the effects of such campaigns be predicted?

The objective of this paper is to discuss this question by reference to the theory of rational behaviour. As a starting point, it is argued that road user behaviour can be regarded largely as subjectively rational. This means that road users behave the way think is best. Road users who behave the way they think is best would normally see no reason for changing behaviour. The theoretical prediction is therefore that campaigns will have no effect. However, empirical research has found that some road safety campaigns do have effects on behaviour and accidents. The theoretical prediction of no effect would thus appear to be wrong. Can this apparent contradiction be resolved? One possibility is to reject the assumption that road user behaviour is subjectively rational. However, it is difficult to explain road user behaviour without assuming at least some degree of rationality. The paper argues that

it remains fruitful to assume that road users are subjectively rational, but only according to a concept of bounded rationality. By making a distinction between bounded and perfect rationality, it may be argued that campaigns can be effective if they make road users aware of the limitations of their rationality and identify more advantageous behaviour. The specific ways in which this may occur are discussed later in the paper.

2 THE THEORY OF SUBJECTIVE RATIONALITY AND ROAD USER BEHAVIOUR

Can road user behaviour be regarded as subjectively rational? Before answering this question, it is necessary to briefly define the concept of rationality and discuss the nature of the theory of rationality. Specific actions and behaviour performed by road users will be defined as subjectively rational if road users believe the behaviour produces more satisfaction than any alternative actions or behaviour (Elster 2007). Briefly stated, therefore, road users are subjectively rational if they behave the way they think is best (according to their own value systems and preferences).

Elster stresses what he calls the radically subjective nature of the theory of rational action. He states (2007, page 209) that it is "subjective through and through", i.e. it refers only to what individuals believe and prefer and not to some external standard. Elster adds that: "One might, to be sure, take the word "rational" in an objective sense, implying that a rational agent is one who makes decisions that make his life go better as judged by objective criteria such as health, longevity, or income. Used in this way, however, the idea would not have any explanatory power." This point of

view is obviously correct as far as explaining choices by showing that they were (subjectively) rational is concerned.

Nevertheless, making a distinction between "subjective" and "objective" rationality can be fruitful. Simon (1955, 1976) first made this distinction when formulating his theory of bounded rationality. In more recent contributions (Kahneman 2003, 2011), a distinction is made between fast and slow thinking and behaviour based on these modes of thinking. While both modes of thinking may shape road user behaviour, in traffic it is likely that only the fast mode of thinking is involved. Fast thinking is intuitive, uses mental shortcuts and minimises the cognitive effort made. It is therefore prone to error and bias. Thus, road users, having to make decisions in few seconds may misjudge gaps in traffic, overlook a vehicle in the blind zone, not brake hard enough, and so on. Table 1 highlights some of the differences between bounded and perfect rationality.

Table 1 about here

Bounded rationality is a descriptive concept. It was developed to describe actual behaviour. Perfect rationality, on the other hand, is perhaps best viewed as a normative concept: it is an ideal to strive for. In nearly all contemporary applications of rationality theory, rationality is subjective, i.e. it refers only to what an individual believes and prefers, not to some external standard for correct beliefs or politically correct preferences. A concept of objective rationality nevertheless makes sense, at least in terms of holding correct beliefs based on scientific evidence. The theory of bounded rationality postulates that individuals do not try to optimise, but settle for choices that are good enough. Herbert Simon coined the term "satisficing" to

describe this and contrast it with optimising. Optimising is a characteristic of perfect rationality as a normative ideal. Options for choice are developed informally and intuitively when behaviour is boundedly rational; perfect rationality requires a formal analysis to develop options for choice. Bounded rationality economises on cognitive resources; thinking is therefore fast and intuitive. Perfect rationality, on the other hand, requires analytic and logically consistent thinking. The influence of social context and frame is seen as strong in descriptive models of bounded rationality, but as something to avoid in prescriptive models of perfect rationality. Finally, learning is informal and unsystematic in boundedly rational behaviour; guided by scientific studies in the ideal world of perfect rationality.

Road user behaviour is characterised by bounded rationality. In principle, therefore, it can be modified to come closer to perfect rationality. However, if road users are satisfied with their behaviour, they will see no reason to change it. This point has been made by several authors. Haight (1986) notes that even for drunk drivers, the most likely outcome of a given trip is that they get safely home. Every time this happens, behaviour is reinforced and messages that emphasise the risk involved in drinking-and-driving are likely to be discounted. At this point, it is important to stress that, within the framework of the theory of subjectively rational behaviour, the only point of view that counts is that of the drinking driver. If we want to explain why people drink and drive, it is completely misguided to adopt the perspective of a moralistic observer who is mainly interested in discouraging drinking and driving. We need to adopt the perspective of the drinking driver and try to imagine how a drinking driver thinks.

In a similar vein, Rumar (1988) points out that the risks faced by each driver are very low. He states that: "Even in developing countries a person would have to drive for a hundred years before killing someone. To the individual driver such risk levels are perceived to be zero, or very close to zero. ... Every individual, in his own opinion, normally drives safely, without any real risk. ... In other words, they perceive that they successfully meet their target risk value of zero." If this analysis is accepted, it follows that no driver will have any motive to change behaviour in order to improve road safety.

Braybrooke (1991) draws attention to what he refers to as the paradox of safety campaigns. The purpose of such campaigns is often to make people less tolerant of risk and influence them to behave more safely. But if current behaviour already reflects safety margins that people regard as sufficient, why should they change behaviour to increase these safety margins? He adds that: "It is paradoxical to campaign for reduction of risks on grounds already accepted by most people."

A common criticism of the theory of rational behaviour is that it has a focus on individuals only, and neglects the influence of social norms and interactions between individuals on their behaviour (Etzioni 1988). This criticism is misplaced. The influence on road user behaviour of social norms and interactions with other road users can be modelled by means of game theory (Elvik 2014). Game theory is the study of interactions between at least two rational actors, each of whom has at least two options to choose between and where the choice made by one of the actors influences the relative desirability of the options for the other actor(s). Game-

theoretic models are eminently suitable to exposing the limits of rationality in road user behaviour. Examples of this, based on game-theoretic models include:

1. Drivers may settle for driving at a speed which is not their most preferred speed, because co-ordinating speed with other drivers is very important (Elvik 2010, Ryeng 2012, Møller and Haustein 2014).

2. There will not be perfect compliance with speed limits, because the interaction between the police and drivers result in an enforcement level that is too low to deter speeding entirely (Bjørnskau and Elvik 1992).

3. Drivers will dip their headlights well ahead of the point where glare becomes a problem, thus driving with suboptimal illumination of the road (Bjørnskau 1989).

4. Drivers will give priority to cyclists who ride their bikes across pedestrian crossings, although the highway code prescribes a different solution: the bicyclist should dismount and walk across the pedestrian crossing. If mounted on the bike, the bicyclist does not have the right of way (Bjørnskau 2014).

In all these instances, road users are behaving the way they find best. It is then not likely that they will see a need for, or any benefit of, changing behaviour. Campaigns designed to change behaviour are then likely to be ineffective.

3 EVIDENCE OF CAMPAIGN EFFECTS

The theoretical prediction of no effect of road safety campaigns is not supported by empirical research. Before briefly reviewing this research, it may be instructive to

define road safety communication campaigns more formally. The following definition is given by Vaa et al. (2009):

"Purposive attempts to inform, persuade, and motivate behaviour changes in a relatively well-defined and larger audience in order to improve road safety, typically within a given time period, by means of organised communication activities involving specific media channels often complemented by interpersonal support and/or other supportive activities as enforcement, education, legislation, commitment, rewards, etc."

According to this definition, a communication campaign is not necessarily limited to persuasive messages, but may include other measures, such as enforcement and rewards. It is important to remember this, since at least enforcement and rewards influence incentives directly in a way that a persuasive message alone will not always do. The subsequent discussion in this paper will focus on campaigns consisting of informative or persuasive messages only.

Phillips, Ulleberg and Vaa (2011) presented a comprehensive meta-analysis of 67 studies evaluating road safety campaigns, containing a total of 119 estimates of effect. The summary estimate of effect was an accident reduction of 10 percent according to a fixed-effects model, an accident reduction of 12 percent according to a random-effects model, and an accident reduction of 9 percent when applying the trim-and-fill method to adjust for publication bias in the fixed-effects model of analysis. All these summary estimates of effect were statistically significant at the 5 percent level.

A particularly interesting part of the study reported by Phillips et al. (2011) is the meta-regression performed in order to identify factors that influence the effects of

campaigns. It was found that campaigns that were combined with police enforcement, campaigns in which the message was delivered roadside (i.e. in real traffic), and campaigns based on face-to-face communication had larger effects than campaigns without these characteristics. These findings are plausible, although the paper does not discuss them by reference to any theory of road user rationality, or the lack of it.

It should be noted that enforcement was used as an accompanying measure in the large majority of the studies reviewed by Phillips et al. Summary estimates of effect therefore reflect the combined effects of information, persuasive messages and enforcement.

4 THE PRESUMPTION OF RATIONALITY AS A NORM

It is instructive to explore the implications of assuming that road users have rationality as a norm, i.e. they try to be as rational as they can and regard apparent failures of rationality as something to be avoided. An apparent failure of rationality is one that road users can discover on their own or readily agree with if told by others. Such failures of rationality include:

1. Unconsciously committing errors or behaving in a way one does not prefer.
2. Not choosing the best action. While one knows that A would be best, one still chooses B.
3. Basing the choice of action on wishful thinking, often in the form of an excessive belief in one's own skills.

4. Basing the choice of action on erroneous beliefs or a lack of knowledge about how to behave the way one wants.

5. Failure to optimally co-ordinate behaviour with other road users.

These are deviations from rationality that the road user himself or herself can gain insight into, and which may therefore motivate the road user to change behaviour. Some examples of the effects of making road users aware of these deviations from rationality are discussed below.

5 MODIFYING ROAD USER BEHAVIOUR BY IDENTIFYING FAILURES OF RATIONALITY

5.1 Unconscious errors

A large part of road user behaviour, in particular driver behaviour, is automated. Automated behaviour does not require conscious choices to be made; it simply unfolds naturally without requiring effort. The extent to which driver behaviour is automated can be revealed by asking drivers to tell in detail what happened on a routine trip. If nothing out of the ordinary happened, most drivers will not be able tell much about the trip.

In automated behaviour, errors can be committed without realising it. Information that makes the road user aware of the error may then influence behaviour. In a Danish trial of Intelligent Speed Adaptation (ISA; systems that help drivers comply with speed limits; Lahrmann et al. 2012), drivers were informed by a voice message when the speed limit was exceeded. The system was informative only and did not

prevent speeding. It was nevertheless found that the message alone reduced speeding. This suggests that some drivers did not intend to speed and were not aware of doing so.

In a British trial (Helliar-Symons and Ray 1986) drivers were informed by means of variable message signs if headway was too short. It was found that drivers increased headway, resulting in a small reduction (6 percent; not statistically significant) in rear-end collisions.

These examples show that by informing drivers about errors they may not be aware of committing, one can influence behaviour.

5.2 Not choosing the best option

A common failure of rationality is to succumb to a temptation one knows should be resisted. Driving home when alcohol has been consumed is an example. In the short run, it is usually the best choice. Alternative transport may be difficult to obtain, and is likely to be more expensive and take longer. Moreover, the driver will need to go back to get the car later. These are hassles one avoids by simply driving home.

Upon sober reflection, however, the driver may understand that drinking and driving should be avoided and may want to avoid it (Wells-Parker et al. 2000). The driver may feel ashamed at having acted unwisely and therefore be motivated to pay attention to messages that are felt as helpful in avoiding drinking and driving. The challenge is to strengthen this motivation sufficiently to prevent the driver from succumbing to temptation again.

One way of strengthening motivation which has been found to be effective is social norms media marketing (Perkins et al. 2010). This type of marketing uses mass media. The key message is that drinking and driving goes against social norms in a peer group (e.g. young drivers); it is not accepted and meets with disapproval from peers. It has been found that such a message can be convincing and contribute to a reduction of drinking and driving (Perkins et al. 2010).

Thus if road users accept that their choices were not the best, even if no adverse consequences arose from them, it is possible to motivate them to avoid repeating choices they may regret.

5.3 Wishful thinking

Wishful thinking denotes beliefs that are influenced by desires; beliefs one holds because it is pleasant to hold them, not because there is evidence to support them. Wishful thinking is a very common deviation from rationality, but road users may not realise they are victims of it.

Most road users, in particular drivers, have a positive self-image. As an example, a large majority of drivers believe they are safer and more skilled than other drivers (Elvik 2013). Overconfidence, i.e. overrating one's skill may be viewed as one form of wishful thinking. Overconfidence can be demonstrated in controlled experiments, as shown by Gregersen (1996). More often, however, it will manifest itself in the form of an unexpected loss of control or a surprisingly sudden erosion of safety margins the driver erroneously thought were adequate. Clearly, such experiences can motivate a driver to change behaviour. It is, on the other hand, more doubtful

whether critical situations designed to counteract overconfidence can be created deliberately.

A persuasive message intended to counteract wishful thinking among road users would somehow need to tell road users that they are not as skilled as they think. It is challenging to design a successful message to this effect, since it is, by definition, unpleasant to give up wishful thinking. No example has been found in the literature of a successful campaign designed to reduce behaviour based on wishful thinking. It would seem that they only way of eliminating such thinking is by getting involved in difficult situations one would have avoided by adopting a larger safety margin.

5.4 Lack of knowledge

If a road user is highly motivated to perform a certain behaviour, but fails to do so correctly, informing the road user about the correct way to perform the behaviour can have a large effect. Perhaps the best example of this, is the use of child restraints in cars.

Presumably, most parents want to protect the children as best they can when driving. Correctly installing a child restraint is, however, complicated and not all parents do it correctly. Information about how to correctly install a child restraint in a car can therefore be very effective and increase the correct use of child restraints substantially (Kessier 2010, Brown et al. 2011).

This shows that when there is a motivation to perform a behaviour correctly, and road users are informed about correct behaviour, the frequency of correct behaviour can increase markedly.

5.5 Failures of co-ordination

Road users need to co-ordinate behaviour to avoid accidents and prevent unnecessary delays in traffic. When roads users fail to do so, they are likely to notice it and be motivated to adopt a more optimal behaviour.

Interestingly, the best choice in situations involving interaction between two road users may not always be identical to behaviour as prescribed by law. An example of this is the Zebra crossing game studied by Bjørnskau (2014). The game involves a cyclist and a car driver. The cyclist intends to cross the road. The cyclist has three options:

1. To cycle across the road.
2. To yield to the car, waiting to cross until it has passed.
3. To dismount the bike and walk across the road.

The driver has two options: to drive or to yield to the cyclist. The interaction between the cyclist and the car driver is shown in Figure 1. It has been assumed that the cyclist makes the first move and that the driver then acts based on his or her prediction of what the cyclist intends to do.

Figure 1 about here

The possible outcomes of the game are shown by the payoffs to the cyclist and car driver. These are ordinal numbers only, meaning that 6 is best, 1 is worst. It is assumed that both the cyclist and the car driver prefer the solution with the highest payoff.

The solution prescribed by the law is that the cyclist should dismount, walk across the road and the driver should yield. This gives a payoff of 5 to the cyclist and 4 to the driver. However, a solution which is better for both road users is possible. The best solution is that the cyclist cycles across the road and the car driver yields. This saves time compared to the legally prescribed solution. Empirical studies show that this solution is chosen about 75 percent of the time, whereas the legally prescribed solution is chosen only about 5-10 percent of the time (Bjørnskau 2014).

It is not always the case that road users develop advantageous informal rules like this. Jørgensen (2007) explains that the informal rule in Denmark is to merge into a queue early, rather than drive to the end of a lane and then merge. This situation is shown in Figure 2. A merging car is expected to behave like the green car in the left part of Figure 2, not like the red car in the right part of Figure 2.

Figure 2 about here

The red car in the right part of Figure 2 is seen as trying to jump the queue, an action most car drivers strongly disapprove of. Yet, if both lanes were used to their full capacity, there might be less delay for everybody. In a case like this, a variable message sign might induce more rational behaviour.

6 CONCLUDING DISCUSSION

The essence of the argument put forward in this paper can be summarised as follows. Road user behaviour is, by and large, subjectively rational. This does not mean that it is perfectly rational from a normative point of view, simply that road users behave the way they think is best. Someone who is doing what he or she thinks is best, will normally not see a reason to change behaviour. Messages calling for this will then tend to be ignored and seen as irrelevant. A motive for changing behaviour will only arise if a road user realises that his or her behaviour really was not the best. This can happen in a number of ways:

1. The road user is alerted to the fact that his or her behaviour was not as intended, e.g. an error has been committed that the road user was not aware of.

2. The road user succumbs to temptation and chooses an action he or she upon reflection knows is not the best.

3. The road user realises that behaviour was based on wishful thinking, i.e. on overly optimistic beliefs about own skill.

4. The road user realises that he or she did not have sufficient knowledge to perform a desired behaviour correctly.

5. Road users interacting with each other discover that formal or informal rules for interaction are suboptimal.

There is evidence that informative or persuasive messages can be effective with respect to points 1, 2 and 4 above. Trying to eliminate wishful thinking (point 3) by telling a road user that he or she is victim of it is difficult. On the other hand, it

ought to be possible to promote optimal interaction between road users (point 5) by means of informative messages.

The next question is whether the effects that have been found in studies that have evaluated the effects of road safety communication campaigns can be explained in terms of the causal pathways identified above. It is, at the current stage of knowledge, impossible to give a comprehensive answer to that question. There are several limits to the validity of evaluation studies that make it difficult to fully explain the findings of these studies. Some of the more important problems include:

1. Not all evaluation studies have controlled very well for potentially confounding factors that may influence the number of accidents, such as long-term trends or regression-to-the-mean. The results of these studies could be biased.

2. Not all evaluation studies have collected the data required to identify changes at all stages of the causal pathway by which a communication campaign can influence the number of accidents. To trace this causal pathway, data are needed both on road user behaviour, accidents and factors motivating changes in behaviour.

3. The quality of the data regarding road user behaviour is dubious in some evaluation studies. In particular, self-reports of behaviour are of dubious validity and may be influenced by many irrelevant factors.

4. Many campaigns have consisted of additional elements influencing incentives, such as enforcement. In such cases, it is impossible to know

whether the effect was generated by the persuasive messages or by the additional enforcement.

In sum, these problems mean that it is impossible to resolve the paradox that safety communication campaigns have been found to favourably influence road safety, despite a theoretical presumption to the contrary. One could, obviously, argue that it is wrong to assume that road user behaviour is subjectively rational.

A fair amount of circumspection is needed, however, to formulate an argument for rejecting road user rationality. One must always remember not to mix up an observer perspective and an actor perspective. From the perspective of an observer, a lot of road user behaviour may appear to be plainly stupid or at least not too well planned. But that hardly proves that it is not rational. The task of the analyst is to model what road users themselves are thinking. It then becomes much harder to argue that road user behaviour in general is not rational. If it is not, then why do road users persist in the behaviour? Again, there is the possibility that road users adopt a pattern of behaviour they themselves do not regard as the best. But this would usually be the result of addictions, cognitive impairment or other factors that inhibit rational choice. If a road user is conscious of such factors, he or she may be motivated to change behaviour.

It is concluded that if it is accepted as reasonable to assume that road user behaviour is, by and large, subjectively rational, the only way to motivate road users to change behaviour is to persuade them that by changing behaviour, they can increase the benefits of travel.

ACKNOWLEDGEMENT

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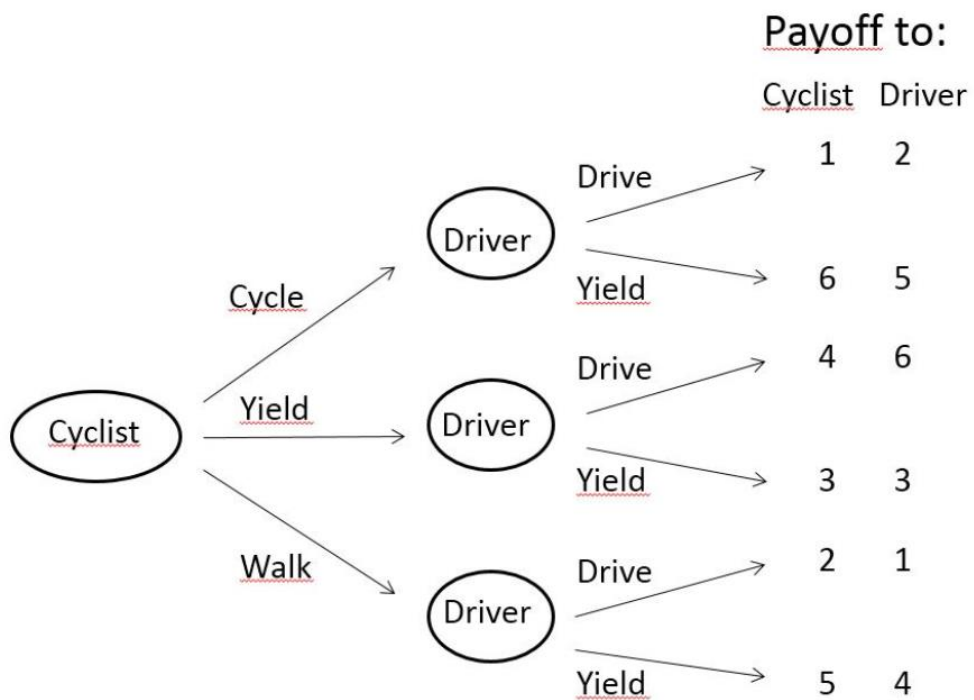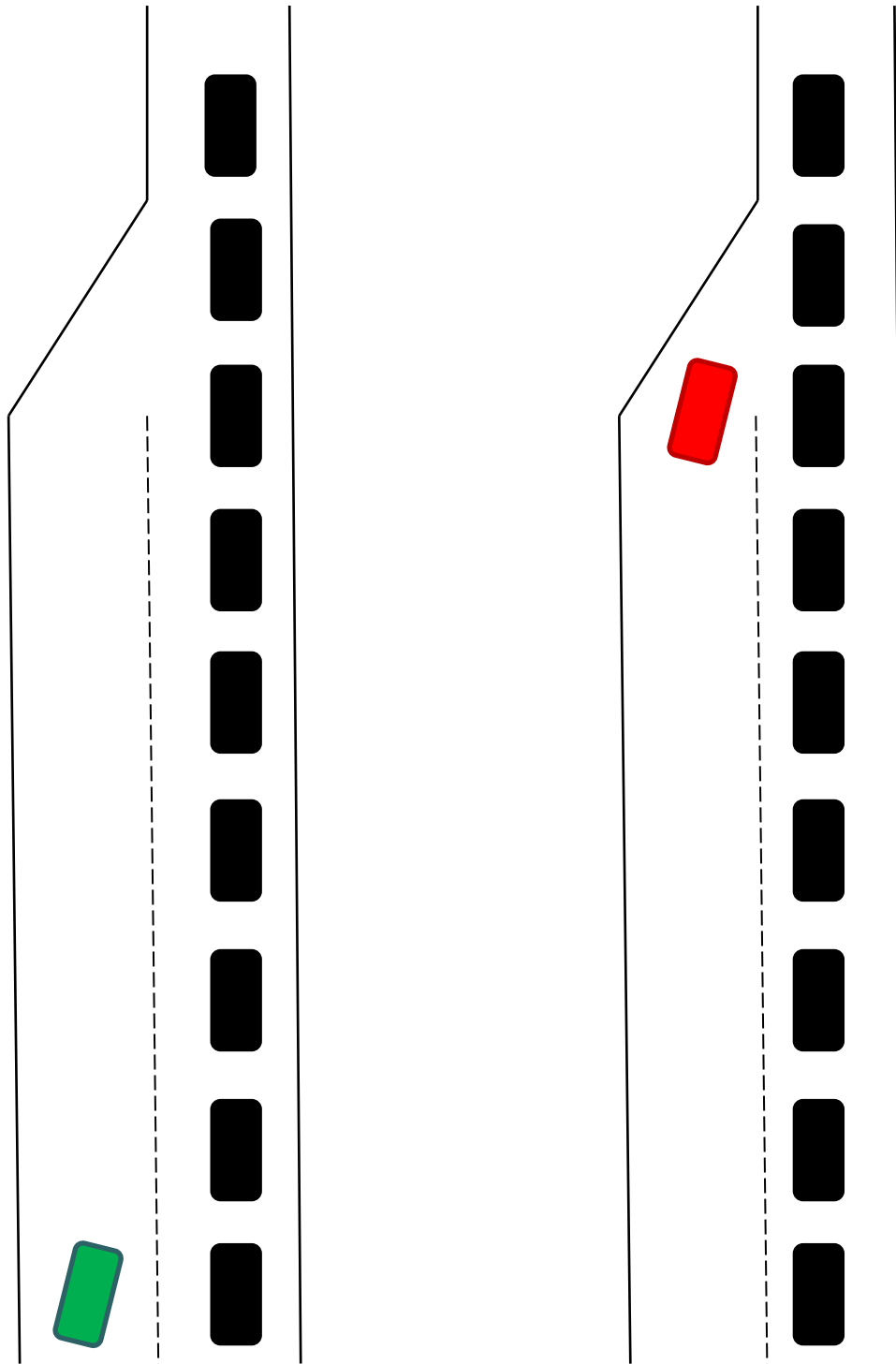
Figure 1: The Zebra Crossing Game in extensive form with ordinal valuations of outcomes 6 > 5 > 4 > 3 > 2 > 1. Source: Bjørnskau 2014

Merging consistent with informal norm   Merging violating informal norm

Figure 2: Merging consistent and inconsistent with informal norms among drivers in Denmark. Based on Jørgensen 2007

Table 1: The dual nature of human rationality

Concept	Bounded rationality	Perfect rationality
Nature of rationality	Descriptive; what people actually do	Normative or prescriptive; what we ought to do
Definition of rationality	Subjective; to be rational is to do what an individual believes is best	Objective; to be rational is to do what is actually best based on objective criteria
Concept of preference	Satisficing; an action is performed if it is felt to be good enough	Optimising; an action is only rational if it fulfils the total set of objectives to a maximum degree
Developing options for choice	By trial and error; habit; imitation; informal thinking	By analysis, e.g. decision trees or other formal tools
Mode of thinking and evaluation	Fast and intuitive; based on heuristics that may generate bias	Slow and analytical; based on computations
Influence of social context and frame	Strong and persistent; rational interactions may be modelled by means of game theory	Context and frame ought not to influence behaviour; game theory is sometimes applied prescriptively
Mechanism of learning	Trial and error; the immediate outcome of an action; imitation; human memory	Scientific experimentation, research and evaluation performed according to high standards of scientific rigour