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Regulating Road Rage

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Abstract

Road rage has been a problem since the advent of cars. Given the ubiquity of road rage, and its potentially devastating consequences, understanding road rage and developing interventions to curb it are important priorities. Emerging theoretical and empirical advances in the study of emotion and emotion regulation have provided new insights into why people develop road rage and how it can be prevented and treated. In the current article, we suggest an integrative conceptual framework for understanding road rage, based upon a psychological analysis of emotion and emotion regulation. We begin by defining road rage and other key constructs. We then consider the interplay between road rage *generation* and road rage *regulation*. Using an emotion regulation framework, we describe key points at which emotion-regulation difficulties can lead to road rage, followed by strategies that may alleviate these difficulties. We suggest that this framework usefully organizes existing research on road rage, while exposing key directions for future research.

Keywords

Road rage; Driving anger; Aggression; Aggressive driving; Emotion regulation; Road traffic crashes

Road traffic crashes are responsible for more deaths world-wide than most diseases, and they are the leading cause of death for children and young adults aged 5–29 years (WHO, 2018). Traffic crashes are also associated with elevated levels of psychological distress (Craig et al., 2016); a recent meta-analysis concluded that the pooled prevalence of posttraumatic stress disorder among road traffic crash survivors was over 20% (Lin et al., 2018). All told, it is reported that, in the United States alone, the medical expenses and productivity losses associated with traffic crashes in 2017 exceeded \$75 billion (Center for Disease Control and Prevention, 2020).

The large majority of road traffic crashes have been attributed to human factors, such as fatigue, intoxication, and angry/aggressive driving behaviors (Petridou & Moustaki, 2000). The National Highway Traffic Safety Administration in the USA estimated that about 67%

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of crash fatalities involve aggressive driving (Goodwin, et al., 2015). The proportion that involve anger is not clear; however, a recent meta-analysis concluded that driving anger is reliably associated with traffic crashes (Zhang & Chan, 2016). Concern with anger and aggression-related driving behavior has evoked scientific interest for more than 7 decades (Tillmann & Hobbs, 1949). However, as we will show, research on this topic is scattered across fields, and a number of crucial questions remain unanswered.

Our goal in this article is to present an integrative conceptual framework of *road rage* and its regulation based upon a psychological analysis of emotion and emotion regulation. We begin by defining road rage and other key constructs. We then adopt an emotion regulation perspective and describe the role of emotion generation and emotion regulation in road rage, followed by strategies that may alleviate these difficulties. We end by showing how our framework helps organize and expose key directions for future research.

Defining Road Rage and Related Constructs

One of the barriers to making progress on road rage is the large number of terms that are used in the diverse literatures that are concerned with road rage. Below, we review different conceptualizations of road rage and propose a working definition of the construct.

Road Rage

The term *road rage* was coined and popularized by the media in the late 1980s. Road rage has since been defined as hostile behaviors that are directed to other road users, including behaviors such as tailgating or colliding with a lead vehicle (Shinar, 1999). Other researchers have suggested restricting the use of the term to describe the most serious forms of aggression, such as forcing someone off the road or drawing a gun at another driver (Galovski et al., 2006; Wells-Parker et al., 2002). Britt and Garrity (2003) have, however, used the term road rage for mild as well as severe forms of driving-related anger expression and argue that the term road rage has the advantage of capturing the totality of a driver's responses when confronted with an anger-provoking situation.

For the purposes of this article, we are primarily interested in the experience of fairly intense and maladaptive experience and expression of anger in the context of driving. Based on the affective science literature (e.g., Mauss, et al., 2005), we view road rage as a multicomponential construct involving loosely coupled changes in subjective experience, behavior, and peripheral physiology. Elaborating on a prior definition of driving anger (Galovski et al. 2006), we propose a working definition of road rage as *a form of fairly intense behaviorally maladaptive anger often cued by driving-related stimuli while operating a vehicle or riding in one as a passenger*. Our conceptualization of road rage places the construct in the intersection of general anger, driving anger, and aggressive driving (see Figure 1). While acknowledging that many of the key constructs used in the present article are somewhat differently defined in different research traditions, we believe that a strategic broadening of the term *road rage* is useful in our effort to draw together disparate research communities. Below, we review how related constructs overlap and describe how road rage may provide a unifying concept useful in a psychological analysis of road rage generation and regulation.

Anger, Driving Anger, and Aggressive Driving

Anger is often thought of as a syndrome that consists of loosely coupled feelings, cognitions, and physiological reactions that are associated with urges to harm some target (Berkowitz & Harmon-Jones, 2004). Anger ranges in intensity from mild (irritability) to intense (rage; Spielberger, et al. 2009). Anger that occurs while driving has been termed *driving anger*, defined as “anger that occurs in response to driving-related stimuli while operating a vehicle or riding in one as a passenger” (Galovski et al., 2006, p. 19). Driving anger does not always have behavioral consequences, and there are reports of drivers finding constructive ways of dealing with their anger (Sullman, et al., 2013). However, just as anger is often associated with aggression (Anderson & Bushman, 2002), driving anger is sometimes (but not always) associated with *aggressive driving* (Deffenbacher, et al., 2016; Sullman, et al., 2013; Zhang et al., 2016). Many definitions have been offered for aggressive driving, such as “driving behavior that intentionally (whether fueled by anger or frustration or as a calculated means to an end) endangers others psychologically, physically, or both” (Ellison-Potter et al., 2001, p. 432). These definitions include a wide range of behaviors, including: speeding, running red lights, changing lanes without signaling, and violent confrontations. One limitation of these definitions is that they do not make a distinction between intentional impulsive aggressive behaviors fueled by anger and a desire to hurt someone and reckless instrumental premeditated aggressive driving which is not necessarily driven by anger or committed with harmful intent (Hennessy & Wiesenthal, 2005). Both driving simulator studies and diary reports have indeed indicated that aggressive driving is sometimes but not always associated with driving anger (Deffenbacher et al., 2016; Deffenbacher et al., 2003; Ellison-Potter et al., 2001).

Road Rage in the Intersection of Driving Anger and Aggressive Driving

As outlined above and depicted in Figure 1, we argue that road rage could be viewed as a form of anger that only occurs in the context of driving, and thus overlaps with driving anger. However, in contrast to driving anger, road rage always includes maladaptive behavioral expressions. We suggest that road rage partly overlaps with aggressive driving, but only hostile (usually not instrumental) forms of aggressive driving, since individuals may drive recklessly and aggressively without being angry. We do not propose that road rage is an emotion experience distinct from anger. However, given its type of emotion, level of emotion, and the context in which it is experienced, road rage may have distinct consequences with applied significance given its implications for road safety.

Few prevalence studies have been conducted at the intersection of driving anger, aggressive driving, and road rage, but the AAA Foundation for Traffic Safety (2016) found that among 2,705 drivers in the US, significant proportions reported that in the past year they had *fairly often* yelled at another driver (9.1%), honked to show annoyance or anger (5.7%), made an angry gesture 3.4%, exited their vehicle to confront another driver (0.7%), and bumped/rammed another vehicle on purpose (0.7%). The foundation concluded that interventions are necessary to decrease the incidence of these behaviors.

Road Rage: The Role of Emotion Generation

Given that anger figures prominently in our definition of road rage, our analysis of road rage begins with a consideration of how emotions like anger are generated. According to the process model of emotion regulation (Gross, 2015), emotions are generated through a series of iterative cycles comprising four aspects or stages: a) a situation; b) attention that determines how the situation is perceived; c) an appraisal (resulting from a comparison between a goal set and a situation construal); and d) a response including subjective experience, physiology, and/or overt behavior (see Figure 2, panel A). Road rage generation may include one or several iterations of this feedback loop. Below, we will describe how road rage can be generated by reviewing antecedents of road rage mapped on these four aspects or stages.

Situation

The most common proximal triggers of road rage include one's progress being impeded (e.g., slow driving), being put at risk (e.g., reckless behaviors of other drivers), and discourtesy or hostility of other drivers (Deffenbacher et al., 2016). While progress impediment is the most common anger-triggering situation, perceived discourtesy seems to elicit the most intense rage (Deffenbacher et al., 2016). More distal triggers of road rage, that may modify the influence of proximal triggers, are warm temperatures (Kenrick & MacFarlane, 1986), the possession of a weapon in the car (Bushman et al., 2017), time urgency, and daily stressful events and work stressors (Wickens & Wiesenthal, 2005). Some studies have demonstrated a relationship between traffic congestion and aggressive driving (Shinar, 1999; Zhang et al., 2015).

Attention

Individuals driving in a simulator who are instructed to focus on anger-provoking elements of the driving situation drive more aggressively than those who focus elsewhere (Stephens & Groeger, 2009), suggesting that raging drivers may focus more on anger-provoking situations than non-raging drivers. Accordingly, rumination has been shown to be associated with higher levels of road rage (Suhr & Nesbit, 2013). Further, Gardner and Moore (2008) coined the term hostile anticipation to describe an angry person's hypervigilance for signs of other peoples' hostile intent. They suggest that for some people, external stimuli are constantly scanned for signs of potential threat, and then over-interpreted in terms of threat and disrespect, which may in part explain how attention mediates rage. Cohen et al. (1998) have shown that individuals high in trait anger have attentional biases toward anger-related cues following perceived insult. In a simulated driving context, Stephens and Groeger (2011) showed that anger provoked in one driving situation may transfer across future driving situations.

Appraisal

As reviewed in what follows, there is ample evidence that the way people appraise a driving situation determines whether road rage is elicited. Thus, it is not the situation per se that elicits the emotion but rather how the situation is viewed in relation to motivational concerns. Uusberg et al. (2019) suggest that an appraisal outcome is the result of a

comparison process between a goal set (i.e., representation of a desired world) and a construal (i.e., representation of how the world actually is). Consider for example a driver who is overtaken by another vehicle and then gets stuck behind the same vehicle as it slows down. One input to the appraisal outcome may be his goal to be on time for a meeting. This goal set is compared to the individual's construal. If the driver construes the event as a sign of being intentionally slowed down, and this construal is compared to his goal of being on time, he is likely to experience road rage (see Figure 2, panel B). To our knowledge, the interaction between goal set and construal has not been explicitly studied in the context of road rage. However, it is widely recognized that anger is often evoked by goal-blocking (Cindy & Eddie, 2020), and as noted above, road rage is commonly evoked by progress impediment (Deffenbacher et al., 2016), suggesting that goal sets are involved. Further, research has shown that if a driver construes discourtesy or threat by another driver, the likelihood of road rage increases (Wickens et al., 2011). This is reflected in the raging drivers' cognitions which, as in general anger (Snyder et al., 1997), typically center around themes of derogation of others, revenge, physical aggression, and disbelieving thinking.

Response

Research from both on-road and simulated driving experiments has demonstrated that road rage is associated with increased heart rate, skin conductance, and respiration rate, as well as altered beta- and delta-waves (Galovski et al., 2003; Herrero-Fernández, 2016; Wan et al., 2017; Yan et al., 2018). Behaviorally, Deffenbacher et al. (2002) have identified three ways people express road rage (which are associated with road rage appraisals): verbal behavior (e.g., cursing); physical expression using one's body (e.g., stepping outside the car to engage in a physical fight); and physical expression using one's own car (e.g., honking).

Road Rage: The Role of Emotion Regulation

So far, we have considered how emotion generation plays a crucial role in road rage. However, emotions – even strong ones such as rage – can often be regulated, and such efforts play a key role in determining whether and how road rage is manifested. According to the process model of emotion regulation (Gross, 2015), emotion regulation is a multi-stage process involving four stages: identification, selection, implementation, and monitoring (see Figure 3, panel A). These stages can be thought of as decisions (conscious or otherwise) involving what if anything about one's current emotional state needs to be modified (*identification stage*), which regulation strategy to use (*selection stage*), which specific actions to take (*implementation stage*), and finally whether to maintain, switch, or stop regulation (*monitoring stage*). For instance (see Figure 3, panel B), a driver might notice that he is more angry than appropriate (*identification stage*) and choose to change how he is thinking about the situation (*selection stage*) by telling himself that the other driver who angered him might have been rushing to the hospital (*reconstrual*, see cognitive strategies) or reminding himself that he actually can find a better use of his time than going to the scheduled meeting if he fails to make it on time (*repurposing*, see cognitive strategies). At some point the driver may notice that he is too upset to reappraise the situation effectively and consider switching strategies (*monitoring*), leading to a new iteration of the emotion regulation process. The emotion regulation framework we have described suggests a number

of points for intervention. In what follows, we consider how difficulties in each of the stages may give rise to road rage and consider interventions targeting each of the main stages.

Identification Stage

Identification-Stage Difficulties.—For some, road rage arises from failure in the identification stage, as the raging driver fails to attend to and accurately identify their emotional state. In over two decades of research on road rage, Deffenbacher (2016) found that many angry college student drivers do not perceive themselves as having a problem with anger, even though they meet criteria for driving anger. Further, individuals who show road rage may misestimate the benefits and costs of an angered state while driving.

Identification-Stage Strategies.—Increasing emotional clarity may help the raging driver to attend to and accurately identify their emotional state. Research has shown that mindfulness is associated with less road rage, suggesting that mindfulness interventions may be suitable for road rage (Stephens et al., 2018). Indeed, Kazemeini et al. (2013) conducted a small randomized controlled trial among taxi drivers and found that a mindfulness-based cognitive therapy, emphasizing non-judgemental emotional awareness training, was superior in decreasing road rage than conventional cognitive behavioral therapy (CBT).

Selection Stage

Selection-Stage Difficulties.—Difficulties at the selection stage may arise from strategic errors. For example, although it is commonly believed that venting anger is helpful, laboratory research indicates that individuals who experience short-term relief from aggressive behaviors are more likely to act aggressively in the future (Bresin & Gordon, 2013). Accordingly, Bushman (2002) has demonstrated that angry individuals who were instructed to ruminate about their anger acted more aggressively than controls. Similarly, research indicates that some drivers use swearing in traffic as a maladaptive strategy to decrease psychological tension (Popusoi et al., 2018). Thus, swearing in traffic may be positively reinforced by short-term relief in anger, and habitually selected to regulate emotions at the expense of more adaptive strategies. The success of a particular strategy may depend on context. For example, laboratory research suggest that distraction may be more effective to regulate high-intensity emotions, compared to reappraisal, while reappraisal is more effective for low-intensity emotions compared to distraction (Shafir et al., 2015).

Selection-Stage Strategies.—Understanding how road rage is generated is useful to understand how it may be prevented and regulated. Interrupting one or several of the road-rage generative stages (situation, attention, appraisal, and response) may hinder the development and/or maintenance of the rage. Thus, we can identify four broad types of road rage regulation strategies, based on which stage they primarily address, namely; situational strategies, attentional strategies, cognitive strategies, and response modulation strategies.

Most CBT protocols for road rage include a brief component of self-monitoring intervention that aims to increase awareness of the clients' own problematic emotion generative cycle. Clients are taught to identify common triggers, cognitions, physiological changes, and behavioral responses in typical problematic situations, and are encouraged to self-monitor

these reactions following an event. This intervention is implemented with the expectation that if individuals learn to see how the road rage is generated, they will be more likely to select an effective strategy the next time they faces a similar challenge (Galovski et al., 2006). Thus, psychoeducation and increasing awareness of road rage generation may increase the likelihood of successful strategy selection. On that note though, we are not aware of any dismantling studies evaluating the isolated effect of this strategy.

Implementation Stage

Implementation-Stage Difficulties.—Road rage may also arise when a person cannot effectively translate a strategy into a situationally appropriate tactic. McRae et al. (2012) have demonstrated that different cognitive change tactics may be more or less effective in relation to different contexts and goals. Indeed, Biassoni et al. (2016) conducted a simulator study in which one group received instructions to reappraise frustrating events by reconstrual while the control group received no instruction. However, although the reappraisal group had fewer traffic violations, they found no effect on level of anger or aggressive behaviours (such as horn-honking). The authors speculate that the lack of effect of reappraisal on road rage may have been due to the particular reappraisal tactic. For example, a raging driver determined to decrease road rage by reinterpreting an event may fail because their exclusive focus on reconstruing responsibility instead of finding positive aspects of the situation. In the following, we consider implementation interventions for each family of strategies.

Implementation-Stage Situational Strategies.—Situational strategies are often included in CBT protocols for road rage as problem solving strategies (Deffenbacher, 2016), in which the individual is instructed to identify potential road rage triggers and think about possible solutions and implement the best one. Situational strategies are also commonly employed in traffic planning by arranging traffic so it flows more smoothly. On this note, the combination of unmanned aerial vehicles and artificial-intelligence technology to detect traffic congestion has been suggested as a promising way to decrease road rage (Jian et al., 2019). Carpooling and public transportation has also been promoted for those that have difficulty dealing with driving-associated stress (Wiesenthal et al., 2016).

Implementation-Stage Attentional Strategies.—Attentional strategies seek to impact road rage at the attentional stage, by changing what aspects of the situation the driver is attending to. For instance, a person behind a slow vehicle may turn on his favorite podcast to distract himself or shift focus to the scenery outside the car. The driving literature contains some evidence that shifting focus may reduce road rage. For example, a driving simulator study found that instructing drivers to direct their focus on different aspects of the driving task impacted their level of aggressive driving (Stephens & Groeger, 2009). Another example is the finding that music has been shown to be associated with lower levels of road rage behaviors due, in part, to distraction (Wiesenthal et al., 2003).

Implementation-Stage Cognitive Strategies.—Cognitive strategies seek to alter road rage at the appraisal stage, by modifying how the situation is viewed in light of goals (repurposing) and/or how the situation is being perceived (reconstrual; Uusberg et al., 2019). Given the prevalence of maladaptive goal sets and situational construals surrounding driving,

CBT protocols often address adversarial attitudes in relation to driving and teach a more supportive appraisals and driving style (Deffenbacher, 2016; Galovski et al., 2006). Two driving simulator studies have explored the use of cognitive reappraisal on road rage-like outcomes with mixed findings. Harris and Nass (2011) found that voice prompts that reappraised frustrating events (i.e., reconstrual) while driving were associated with less negative emotion (including anger) when compared to control conditions. Biassoni et al. (2016) extended Harris and Nass's (2011) study to road rage in a randomized controlled trial comparing reconstrual-type instructions with no instruction. The authors suggest that the lack of expected findings may be due to exclusive use of reconstrual (e.g., as opposed to repurposing) tactics. Cognitive strategies have, however, successfully been evaluated both as a stand-alone treatment and in combination with relaxation and behavioral interventions within a CBT-framework. These interventions have consistently produced decreases in road rage outcomes (Deffenbacher, 2016; Feng et al., 2018).

Implementation-Stage Response Modulation Strategies.—Response modulation strategies aim to modify road rage at the response stage, by addressing the emotion-related physiological or behavioral changes. For instance, a person experiencing road rage may practice relaxation when angered by someone blocking their way. Applied relaxation has been studied as a stand-alone treatment as well as in larger CBT-packages for road rage (Deffenbacher, 2016). For example, Deffenbacher et al. (2000) have found that relaxation skills taught over eight weekly sessions decrease self-reported road rage symptoms compared to no-treatment control. In the context of court-mandated treatment for aggressive drivers, Galovski et al. (2003) found that a relaxation intervention led to self-reported decreases in road rage as well as pre- to post-treatment decreases in heart rate and blood pressure while listening to idiosyncratic stressful driving vignettes. However, compared to active control conditions, relaxation has been found to be equivalent rather than superior to treatments such as cognitive interventions (Deffenbacher, 2016). Other forms of response modulation may actually increase road rage. Thus, expressive suppression (i.e., preventing outward expression of driving anger) has been found to moderate the relationship between driving anger and aggressive tendencies, suggesting that drivers who habitually use emotional suppression act more aggressively while experiencing anger (Popoi & Holman, 2016).

Monitoring Stage

Monitoring-Stage Difficulties.—Road rage may develop and/or be maintained if there are difficulties monitoring the regulation process in terms of whether to maintain, switch or stop the regulation attempt when it is not situation-appropriate. This may happen if a raging driver is having difficulties determining what level of driving anger is a realistic goal, giving up on a strategy too early, or maintaining a strategy although it is not beneficial.

Monitoring-Stage Strategies.—Few studies have investigated strategies specifically related to monitoring of emotion regulation (for an exception, see Zich et al., 2020). However, CBT interventions for road rage include components of realistic goal-setting and encouragement to practice both persistence and flexibility while practicing new skills (Deffenbacher, 2011). Clients in CBT are usually asked to practice different road rage

regulating skills between sessions, employing them in situations of increasing levels of difficulty, meanwhile self-monitoring to track success. Between-session assignments are usually reviewed by the therapist who helps the client problem solve if necessary (e.g., Galovski et al., 2006). Hence, in CBT, clients with road rage typically practice monitoring of emotion regulation skills while applying the skills, between and during sessions. However, this particular treatment component has to our knowledge not been studied in isolation.

Directions for Future Research

In this article, we have considered road rage from an integrative perspective based upon a psychological analysis of emotion and emotion regulation. We have suggested that effective management of road rage requires a careful analysis of how road rage is generated and the various possibilities for its regulation. In the following, we consider several inter-related directions for future research on road rage.

To date, most research has focused on the implementation stage of the emotion regulation cycle. Future studies of road rage should broaden focus to all stages in the emotion regulation process. The identification stage may be particularly important in the case of road rage, given that many individuals with documented driving anger do not perceive themselves as having problems with road-related anger (Deffenbacher, 2016). For an angry individual, anger is generally not perceived as a personal problem and a failure to identify oneself as angry is associated with low readiness for change (Deffenbacher, 2011). Thus, learning more about determinants, consequences, mechanisms, and interventions related to the identification stage should be considered a research priority. For example, preliminary findings from a study on stress and emotion suggests that a history of mindfulness-based therapy is associated with greater reappraisal ability (Troy et al., 2012). Consequently, as has been suggested elsewhere (Deffenbacher, 2016), studies should explore whether the employment of emotional awareness strategies improve consecutive reappraisal attempts in a driving setting.

Any road rage intervention, on the level of the individual or society, needs to consider which stage of the emotion-generation process regulatory efforts will most successfully target. For instance, if road rage is prevalent in a particular context, and the situation is amenable to change, strategies should focus on changing the situation and thereby changing the course of road rage generation in its earliest stage (e.g., by joining a car pool on an individual level or improving traffic flow on a societal level). However, if the situation cannot readily be modified, it may be more sensible to address later stages in the emotion generation process. Importantly, emotions not only gain strength over time by moving from one stage to the next in a single iteration; they also may increase in intensity over several iterations (i.e., moving from one situation–attention–appraisal–response cycle to a second one; Gross, 2015). This raises interesting questions about relative effectiveness of strategies depending on temporal progression from one emotion generative stage to the next as well as from one iteration to the next. Indeed, relative timing of emotion regulation strategy (both within one iteration and of earlier versus later iterations) has been associated with regulation success (Sheppes & Gross, 2011). However, although it has been previously recognized that different CBT interventions for anger (e.g., self-monitoring, reappraisal, and relaxation) theoretically

address different targets in the anger generation sequence (Deffenbacher, 2011), examination of the role of timing of interventions has so far been largely neglected in road rage experimental and intervention research and should be considered for future studies.

Another important question concerns the efficacy of combining emotion regulation strategies (Aldao & Nolen-Hoeksema, 2013). Recent work suggests that flexibly switching between different emotion regulation strategies is favourable to only using one single strategy (Blanke et al., 2020). However, questions concerning temporal effects of combinations of strategies, in relation to the unfolding of an emotion, remain largely unanswered (Blanke et al., 2020; Kalokerinos et al., 2017; Peuters et al., 2019). For instance, findings indicating that reappraisal works better for low than high emotional intensity (Shafir et al., 2015), may suggest that reappraisal is more effective when it follows on other strategies that first can bring the emotion down to moderate levels. Thus, efforts to reappraise a perceived traffic norm violation might work better when preceded by distraction or relaxation strategies. Related questions are whether road rage is linear and also whether the strategies articulated in the present paper are equally effective across all levels of road rage, ranging from fairly intense anger to intense rage. Questions about moderators of road rage generation (e.g., personality) and moderators of emotion regulation (e.g., emotional intensity) should be addressed in future research.

On the level of implementation, further investigation should consider the separate and combined effects of regulation tactics within the different emotion regulation strategy families. For instance, concerning reappraisal, most research has so far focused on reconstrual of a situation. According to our framework, interventions would likely benefit from including experimental manipulations of different reappraisal tactics (Uusberg et al., 2019), such as studying the separate and combined effects of repurposing and reconstrual.

Generally, although several clinical outcome studies have demonstrated that cognitive strategies, relaxation, and mindfulness may decrease road rage, little is known about mechanisms of change during these interventions (Deffenbacher, 2016). For example, although cognitive interventions have been shown to be associated with an increase in habitual use of reappraisal and decrease of road rage (e.g., Feng et al., 2018), to our knowledge, none has studied how and when that change is produced. Future intervention studies should include repeated measurements of both potentially competing mediators and road rage symptoms, clinically testing hypotheses that have ideally been built from the bottom up, based on laboratory studies. Further, as noted previously, CBT-packages typically include interventions targeting several different emotion regulation stages and strategies at once. Ideally, treatment packages should not exist for long before they are dismantled and different components are studied separately (Hofmann & Hayes, 2019).

As noted previously, most CBT-protocols include self-monitoring exercises encouraging clients to monitor their regulation attempts. However, these types of interventions have not been studied in isolation. One of the few studies evaluating emotion regulation monitoring interventions include a recent laboratory study that provided participants with real-time information of their brain activity (Zich et al., 2020). This study utilized functional magnetic resonance imaging-based neurofeedback, a type of intervention that could be a valuable

addition to the growing body of studies assessing neural correlates in simulated driving contexts (Palmiero et al., 2019).

We have so far predominantly considered situations in which drivers regulate their own emotions (i.e., intrinsic emotion regulation). Within the broader field of emotion regulation, growing attention has been directed towards the process of regulating someone else's emotion (i.e., extrinsic emotion regulation; e.g., Nozaki & Mikolajczak, 2020). Road rage provides interesting opportunity to study potential passenger-effects on both its generation and regulation. Passenger conversations have been shown to increase driving situation awareness (Drews et al., 2008). However, important questions remain as to whether passengers can assist drivers in correctly identifying their emotions, in selecting and implementing road rage regulation strategies, and in monitoring regulation success. Such research would inform scientists, therapists, vehicle engineers, and driving educators, in how to best notify drivers that they are showing early signs of anger in a validating and effective manner; as well as how to communicate emotion regulation strategy prompts.

In sum, then, we believe road rage offers unique research opportunities to address these questions as its cycles of anger and aggression occur within a confined space that can be studied in both real-world and ecologically valid simulated settings, in which controlled, repeated measurements can be undertaken. These types of studies could provide the research community with robust standardized transportable experimental paradigms that allows for replication. We expect that findings from such studies may not only help advance our understanding of road rage but of anger, aggression, and emotion regulation in general.

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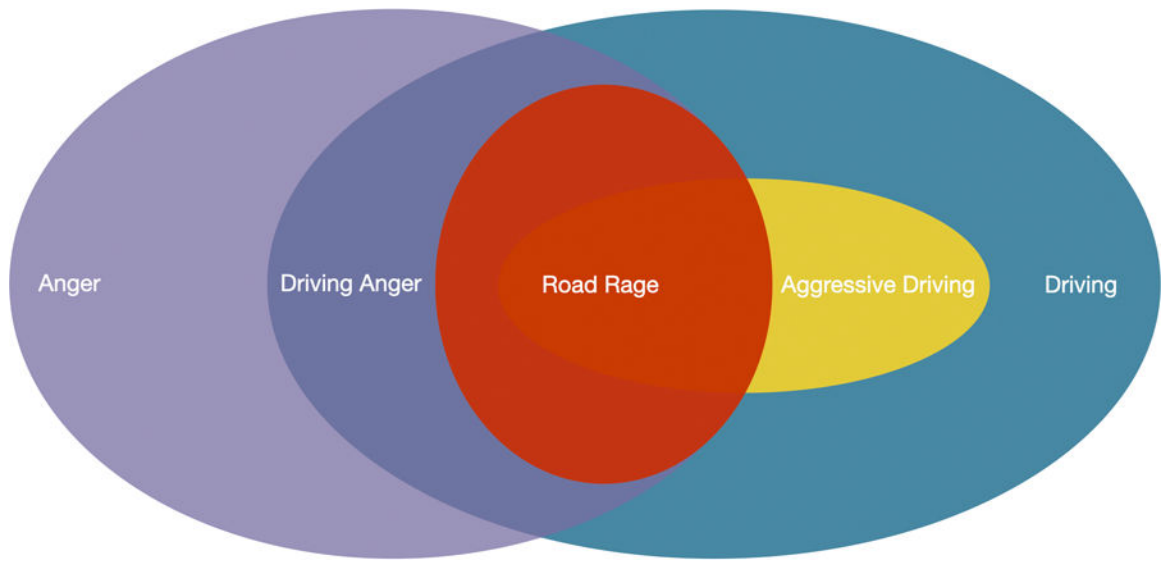


Figure 1. Venn diagram illustrating how anger, road rage, aggressive driving, driving anger, and driving relate to each other.

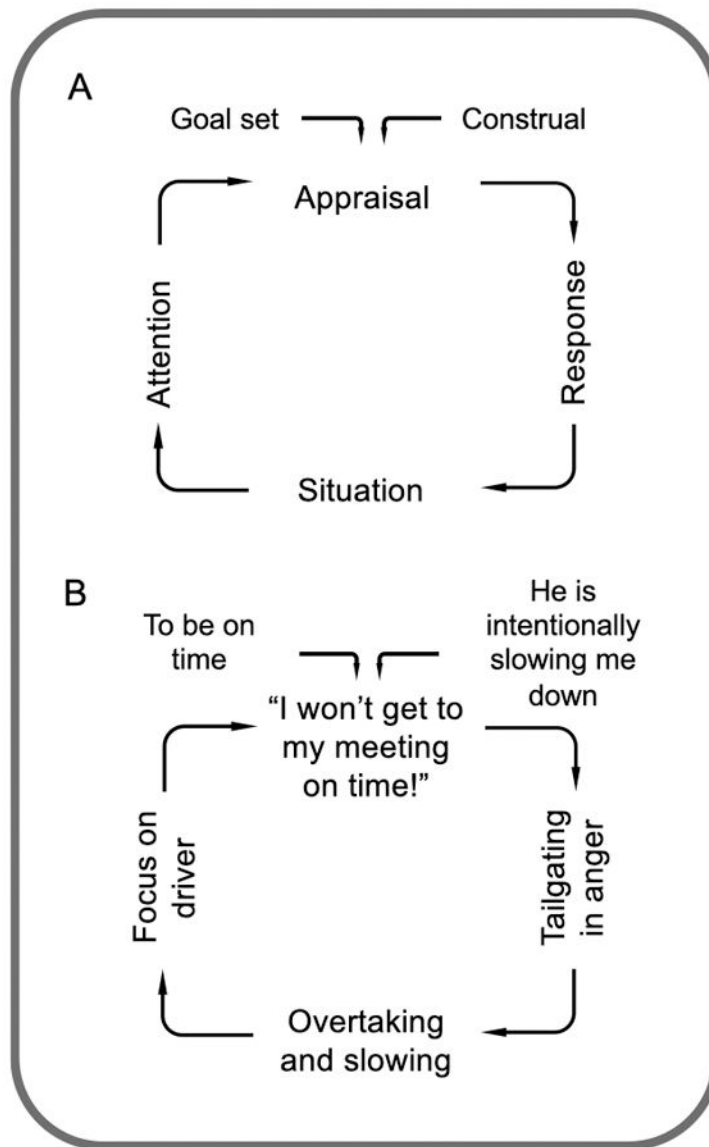


Figure 2.

Panel A depicts structural and dynamic aspects of emotion generation. Panel B illustrates an example of road rage generation in which a driver is overtaken by another vehicle and then gets stuck behind the same vehicle that has slowed down. The driver starts imagining what intentions the other driver had. The driver compares his goal set (i.e., to be on time) with his construal (i.e., that the other driver was intentionally slowing him down). This comparison process results in an appraisal that he will not get to his meeting in time. Based on this appraisal, the driver experiences an urge to seek revenge and angrily starts tailgating the driver who passed him and then slowed down.

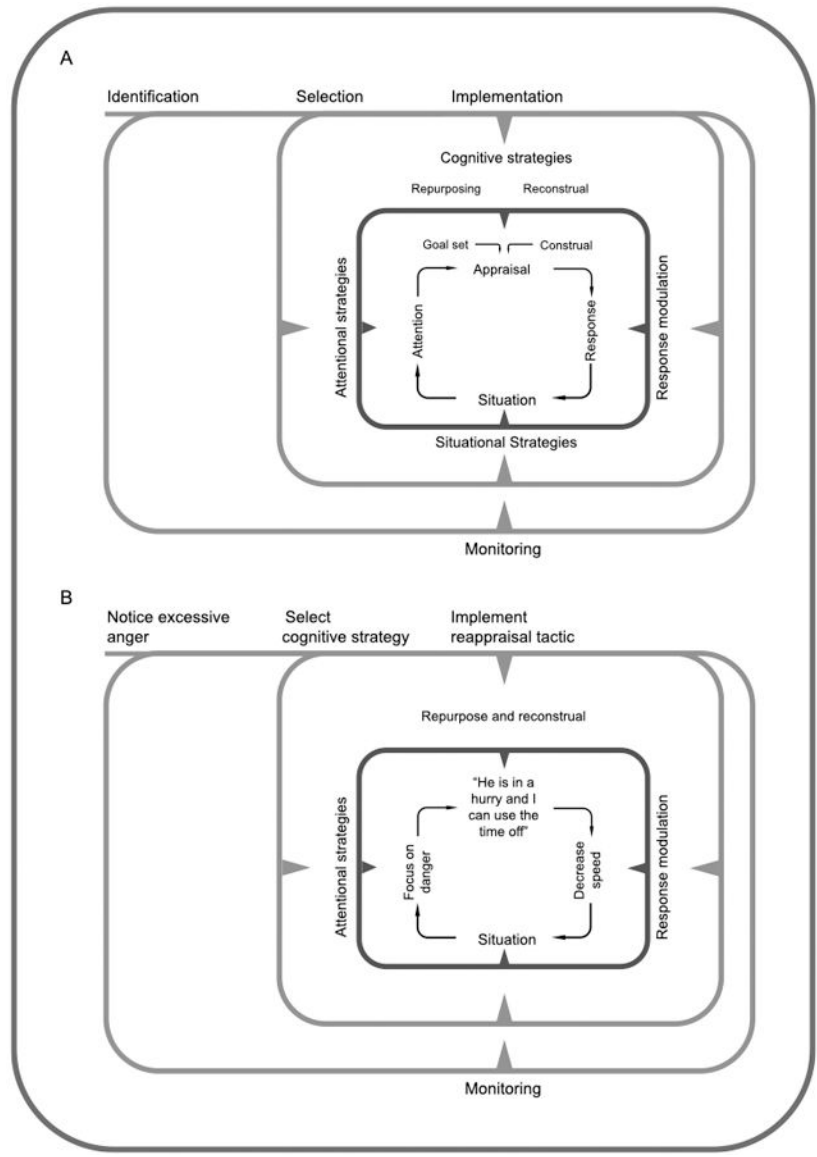


Figure 3. Panel (A) depicts structural and dynamic aspects of emotion regulation. Panel (B) illustrates an example of road rage regulation. In this example, a driver notices that he is experiencing more anger than he wants, and decides to regulate the emotion. He decides to employ a cognitive strategy and implements a certain reappraisal tactic by reappraising level of responsibility of the other driver’s actions. He decides to attribute the overtaking to understandable factors, telling himself that the other driver might be rushing to a hospital. He also reminds himself that he can find other things to do if he does not make it to the meeting in time. He decides to decrease his speed and eventually experiences a decrease in road rage.