Article

Relating Reactive and Proactive Aggression to Trait Driving Anger in Young and Adult Males: A Pilot Study Using Explicit and Implicit Measures

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Abstract: Driving anger and aggressive driving are main contributors to crashes, especially among young males. Trait driving anger is context-specific and unique from other forms of anger. It is necessary to understand the mechanisms of trait driving anger to develop targeted interventions. Although literature conceptually distinguished reactive and proactive aggression, this distinction is uncommon in driving research. Similar, cognitive biases related to driving anger, measured by a combination of explicit and implicit measures, received little attention. This pilot study related explicit and implicit measures associated with reactive and proactive aggression to trait driving anger, while considering age. The sample consisted of 42 male drivers. The implicit measures included a self-aggression association (i.e., Single-Target Implicit Association Test) and an attentional aggression bias (i.e., Emotional Stroop Task). Reactive aggression related positively with trait driving anger. Moreover, a self-aggression association negatively related to trait driving anger. Finally, an interaction effect for age suggested that only in young male drivers, higher proactive aggression related to lower trait driving anger. These preliminary results motivate further attention to the combination of explicit and implicit measures related to reactive and proactive aggression in trait driving anger research.

Keywords: trait driving anger; reactive and proactive aggression; cognitive bias; implicit measures; male drivers; young drivers

1. Introduction

Anger is a highly arousing and negative emotion that is often experienced while driving. Consequently, drivers may display outward expressions of aggression, either verbally or behaviourally [1]. A population survey measured over a one-month period indicated that 60% of drivers became extremely angry about another driver's behaviour [2] and a US News and World report survey among drivers indicated that anger while driving is experienced or witnessed in other drivers by more than 90% of drivers [3]. Driving anger often leads to increased driving errors, less speed compliance and is considered to be a leading cause of aggressive driving [4–6]. Aggressive behaviour is defined as any behaviour performed with the intention to harm another person to avoid being hurt or injured him or herself, with specific emphasis on the intentional aspect of the act and not depending on the consequences of the harm [7]. Driving anger and aggression are believed to be main contributors to motor vehicle crashes [5]. For instance, the AAA 2019 Traffic Safety Culture Index [8] indicated that drivers with a crash history in the past two years were more likely

to engage in aggressive driving behaviour(s), compared to those without crash history. Therefore, aggressive driving behaviours are perceived to be a serious threat to road safety. However, the willingness to consider or engage in aggressive behaviours is a reoccurring phenomenon among drivers [8–10]. Reducing aggressive driving would lead to less risk of injuries and deaths on the roads, and help society move towards more sustainable transportation. Therefore, it is necessary to understand underlying mechanisms of trait anger, as understanding can help to develop targeted interventions aimed at reducing acts of aggression [11,12], or in this case, acts of aggressive driving.

Male drivers engage in aggressive driving behaviours more frequently compared to females [7]. Although female drivers were found to experience more anger than men about other drivers' reckless driving behaviour and slow vehicles, they were more likely to control that anger. This prevented female driver from engaging in aggressive driving, as compared to male drivers who reacted more aggressively in these traffic situations [13]. Furthermore, several studies indicated that driving anger predominantly occurs among young drivers and declines with age [13]. Young drivers experience more anger while driving [14] and engage in risky driving behaviour more often as compared to adult drivers [15]. One important contributing factor is the lack of experience with inconvenient traffic situations, which can lead to higher levels of frustration and arousal. Another important factor concerns cognitive development. Adolescents and young adults up to 25 years are still developing cognitively due to the ongoing maturation of the prefrontal cortex [16–18]. During this time, immature cognitive control is outweighed by strong impulsive reactions and physical arousal towards experienced threats. This is especially the case in young males with high levels of testosterone and, among other cognitive functions, low response inhibition [15,19]. Still, findings on the relationship between age and driving anger are inconsistent within the literature. This could be related to the varying age ranges in previous studies; half of the published studies investigated drivers 25 years and younger. The probability of finding age effects is lower when using small age ranges [14]. Therefore, driving anger studies should include broader age ranges.

Based on demographics, such as age and sex, a first assessment of drivers prone to driving anger, and a determination of who could potentially be selected to participate in driving anger reducing interventions, can be made. However, such factors are not susceptible to change. Therefore, it is necessary to identify additional contributing factors to driving anger that allow for an assessment of driving anger tendencies, and that could also serve as possible targets for interventions.

1.1. Trait (Driving) Anger

Individual differences that demonstrate aggressive behaviour can be associated with trait anger. Trait anger can be seen as a long-lasting tendency to experience state anger, which is a fleeting emotional physiological reaction, to a greater extent, intensity and duration [11]. Higher levels of trait anger are related to adverse outcomes such as increased aggressive behaviour in daily life, and, in particular, it also relates to aggressive driving [11,12].

Trait driving anger, or the tendency to become angry behind the wheel, is a context specific dispositional factor influencing driver aggression that is unique from other forms of anger [20]. Deffenbacher et al. [21] developed the Driving Anger Scale (DAS) to measure individual differences in the level of anger evoked within a context specifically related to motor vehicle driving, allowing for the measurement of trait driving anger. The DAS scale was used extensively after that, especially by the group from Deffenbacher (for a review of 20 years of research, we refer to [14]). From that research, several findings can be summarized. Individuals scoring high in trait driving anger are drivers who report more triggers for anger while driving and experience more intense and regular feelings of anger. They also think in a more hostile aggression-oriented manner. Moreover, these drivers are more likely to express anger in less adaptive or constructive manners, and with more display of verbal or physical aggression when put in situations that the driver

perceives as provoking [14,22]. Drivers with high trait driving anger tend to overestimate the importance of the situation and display negative interpretations, while lacking thoughts to neutralize and/or control feelings of anger [23]. Furthermore, high levels of trait driving anger motivate the driver to drive impulsively and riskily while regularly displaying aggressive driving behaviour and experiencing more crash-related conditions [14,23,24].

1.2. Reactive and Proactive Aggression

Commonly, a dichotomous division of aggressive behaviour into two types or functions is proposed in the literature: reactive and proactive aggression. Reactive aggression, the type that has already been linked to (trait) anger and anger regulation difficulties, is triggered by feelings of anger and frustration when provoked by others. In contrast, proactive aggression is goal-and reward-orientated (e.g., overcoming obstacles and avoiding delays) and is based on positive outcome expectancies that are not dependent on physiological arousals or provocation [25,26]. So conceptually, trait anger overlaps with the concept of reactive aggression [27]. Relevant for the current purposes, age previously related to reactive but not proactive aggression, with reactive aggression declining with age, while proactive aggression did not [28,29].

Several researchers have criticized the dichotomous division of aggression into two distinct categories because the same individual can engage in both reactive and proactive aggression. Therefore, it is suggested that researchers consider reactive and proactive aggression as co-occurring dimensions, often with high inter-correlation, instead of independent categories [30–34]. Despite this overlap, reactive and proactive aggression previously revealed unique co-morbidity and distinctive correlations with several behavioural, cognitive and developmental characteristics [35,36], adding to the usefulness of making a conceptual distinction. However, this distinction is rarely applied in traffic safety [37], and to the best of our knowledge, it has not been related yet to trait driving anger in (young) male drivers.

1.3. Cognitive Biases and Implicit Measures
1.3.1. Cognitive Biases

"The activation of anger and aggression is a product of cognitive processing, whether deliberative or automatized" (p. 4, [38]).

A cognitive approach to trait anger and aggression has been prominent in previous literature, indicating that high levels of anger can be attributed to cognitive processes or biases in these processes. Although different social-psychologic models emphasize different concepts, a shared assumption is that how someone processes hostile situational input on a cognitive level constitutes an essential correlate of the angry and aggressive reactions that may follow. People with high trait anger respond differently in certain types of situations and are also more reactive to hostile input [12]. A complete overview of the existing models goes beyond the scope of the current article. Instead, we focus on one influential social-cognitive theory. The Social Information Processing (SIP) model (e.g., [39]) postulates that different information processing of social-environmental information patterns can lead to increased anger and aggression [40,41]. Six different steps in situational information processing are described in the model, including automatic and controlled cognitive processes. Step 1 is the encounter of social cues, step 2 is the interpretation of these cues, step 3 is the selection of goals, step 4 is the retrieval of past behaviour and actions from memory, step 5 is the evaluation of the potential actions and behaviour and finally, step 6 is the selection of the actions and the behaviour that will be displayed [39]. Past social experiences, social expectancies, knowledge of social rules, emotional reactivity and the ability to regulate emotions can play a role in each step and thereby bias the information processing leading to aggressive behaviour [42,43]. Therefore, the model posits that processes in earlier and later cognitive processes, together, contribute to individual trait anger and reactive aggression levels (i.e., related to attention, interpretation and effortful control [27]). Together with the encoding of cues that require attention, the interpretation

of those cues represent the earlier social information processing stages that are thought to cause reactive aggressive behaviour due to the misinterpretation of unclear and ambiguous situations, evoking threat [44]. Previous studies supported assumptions made by the model by showing that increased anger and aggression are related to biases in selective attention and the interpretation of ambiguous behaviours, two stages of information processing relevant to hostile reactivity [12,40]. Thus, early selective attention processes preferring hostile information, especially when hostile intent is ambiguous, can lead to more frequent induction of anger and higher levels of trait anger [12,27]. Moreover, reactive aggression, compared to proactive aggression, is related to mechanisms such as a hostile attributional bias and feelings of anger [35,41,45]. Meanwhile, proactive aggression is related to different mechanisms such as self-efficacy and positive outcome expectancies [41].

Interestingly, identifying cognitive biases related to anger and aggression could make it possible to alter them via cognitive bias modification (CBM). In general, CBM is aimed at modifying a particular cognitive bias in a certain direction and often refers to attentional and interpretative training [46]. Moreover, as the different kinds of cognitive biases are related, reducing one type of bias could also influence another type [40]. Despite the upsurge of CBM studies, critiques were also posed due to the small to moderate effect sizes of the interventions, although this also relates to a lack of power and reliability of current protocols. Therefore, more rigorous research is called for to enhance the effectiveness of CBM interventions [46]. A full description of the CBM domain, however, goes beyond the scope of the current article as we will focus on the assessment of driving anger proneness, not the modification.

1.3.2. Implicit Measures

Social cognitive research indicated that one could act in a biased manner without the intention to do so. This assumption has led to the use of implicit measures, which were developed to reflect cognitive biases by assessing thoughts and feelings without asking them directly [47]. A common conception in previous literature is that implicit measures always capture unconscious representations and explicit measures capture conscious representations. However, although implicit measures do not require introspection, this does not mean that the assessed representations are always entirely unconscious [48]. For instance, Hahn et al. [49] let participants predict upcoming results in an implicit attitude IAT measurement and revealed that these predictions were surprisingly accurate, despite a low correspondence between explicit and implicit attitude measurement. In a similar vein, explicit measures do not guarantee a distinct memory representation that is independent of the automatically activated representation [50]. Similarly, implicit measures were previously described as targeting automatic processes while explicit measures were seen as targeting controlled processes. However, literature shows that the performance of implicit measures can also be influenced by deliberate, controlled processes. So, although implicit measures constrain controlled processes more than explicit measures, to some degree, they can still reflect controlled processes. The extent to which controlled processes are included will depend on the characteristics of the implicit measure at hand [49,51–53]. The conceptualization of automatic versus controlled reflects the processes leading to a response. Another way of classifying tasks is based on the measurement procedure. A measurement can be direct if the outcome is based on self-assessment of the measured concept. Meanwhile, a measurement can be indirect if the outcome is not based on self-assessment (e.g., reaction time performance) or based on a self-assessment of concepts that are not the to-be-measured concept (e.g., liking of an object that follows the concept of interest) [48]. For the current purposes, we focus on measures that reflect indirect versus direct measurements to assess representations of aggression, and these representations may vary in the degree to which they reflect (un)conscious content. Thus, we are not focussing on the underlying processes leading up to the response. However, in line with terminology usually reported in the literature, we will use the terms implicit versus explicit instead of direct versus indirect throughout the manuscript.

A plethora of implicit measurement tools exists, and the selection of the preferred tool should depend on the research questions at hand, e.g., based on measurement procedures or the assessed psychological attributes [48]. A well-known example is the Implicit Association Test (IAT), one of the most used implicit measures. The IAT aims to assess thoughts and feelings based on the measurement of speed and accuracy when someone sorts different stimuli (e.g., black and white faces) into categories (e.g., good and bad). Participants that are forced to sort objects in a manner that conflicts with stereotypes and people with prejudices typically respond slower and make more mistakes [47]. This contrasts with the nature of explicit or self-report measures that measure these concepts by asking people directly. An explicit measure is still one of the most important tools in social and personality psychology. However, they come with some downsides, such as unwillingness or lack of ability to provide accurate information about the measured concepts. In addition, their usefulness seems limited for concepts that are not accessible via introspection or are unconscious. Implicit measures were initially developed to overcome such limitations. Generally, it has been found that implicit measures are able to predict behaviour and even add to the prediction that explicit measures make. However, it is likely that a combination of both measures is the best option [48,51].

In a study using a correlational design, Brugman et al. [28] combined explicit and implicit measures to determine correlates of reactive and proactive aggression. Reactive and proactive aggressive behaviour was related to the performance on implicit measures thought to reflect biases in earlier (i.e., Emotional Stroop Task; EST) and later (i.e., Single Target Implicit Association Test; ST-IAT) processing stages, identified by the SIP model described above. More specifically, the EST, a measure of attentional interference by aggressive word stimuli, was found to relate to reactive aggression. Meanwhile, the ST-IAT, a measure of self-association with aggressive word stimuli, related to proactive aggression [28]. This supports the assumption that reactive aggression relates to the earlier, and proactive aggression to the later SIP stages [28,41]. Brugman et al. [28] concluded that tasks measuring cognitive factors related to aggression, such as the ST-IAT and EST, can be a useful addition to existing risk and aggression assessment methods that are, for instance, based on subjective data.

Although traffic safety research applying implicit measures is still scant [54], studies are increasing (e.g., [20,54–58]). For instance, Sani et al. [58] used an EST and found that an attentional bias towards emotional stimuli related to driving errors. Bıçaksız et al. [55] adapted the IAT for an implicit evaluation of driving skills, combined with an explicit evaluation. Both measures showed different relations to the outcome measures of driving behaviour and performance. Moreover, the IAT moderated the relation between self-reported skills and some of the outcome measures. Similar to the statement made above, the authors concluded that a combination of both explicit and implicit measures are necessary to understand driver skill evaluation [55]. Relevant to the current study, Blankenship & Nesbit [20] studied the implicit memory retrieval of aggressive-related concepts in two different studies after being primed with driving-related stimuli. They found that for high DAS participants, neutral driving cues primed aggressive knowledge structures as compared to neutral stimuli, which was not found for low DAS participants. Their results supported the assumption that hostile cognitions, conscious or unconscious, could be a mechanism behind the relation between trait anger and aggression.

To paraphrase, a combination of explicit and implicit measures should be used to assess cognitive biases related to anger and aggression. Due to the previously reported relation between anger and reactive aggression, correlates of reactive and proactive aggression, combined with outcomes on explicit measures, could be useful to assess the presence of high trait driving anger in certain individuals. Consequently, the outcomes of these measures could identify potential targets for interventions, e.g., including CBM training. However, to the best of our knowledge, no former research related reactive and proactive aggression to trait driving anger by using a combination of explicit and implicit measures, which would be a crucial first step.

2. Research Aims

The current study concerns a correlational pilot study based on the study by Brugman et al. [28] that aimed to determine whether explicit and implicit measures related to reactive and proactive aggression can be applied to trait driving anger. Building further on the information described above, the current study only focuses on male drivers. In addition, a specific focus on young drivers is included in determining whether reactive and proactive aggression and their correlates, an attentional bias and self-aggression association, relate differently to trait driving anger in young and adult drivers. Drivers up to 45 years are included, allowing a broader age range, and the age of 25 delineates the young driver sample. The following research questions are posed:

1. Is trait driving anger in males related to age?
2. Is trait driving anger in males related to reactive aggression, proactive aggression, or a combination of both aggression types, as measured with explicit self-report?
3. Is trait driving anger in males related to correlates of reactive and proactive aggression, attentional bias, and the self-aggression association?
4. Does the relationship between trait driving anger and the explicit or implicit measures related to reactive and proactive aggression differ per age category?

3. Materials and Methods

3.1. Participants

The recruiting process included circular emails from university staff, social media and personal networks around the area of Limburg in Belgium. Interested participants were able to contact the lab via email. The participants were required to own a driver's license for at least one year and to drive on a regular basis (every week). Male drivers between 17 and 45 years were recruited for this research. In Belgium, adolescents are able to obtain a preliminary driving licence at the age of 17. Dependent on the number of driving lesson hours, they are allowed to drive without supervision under restricted circumstances (e.g., restricted nighttime driving). Since no 17-year-old responded, the minimum age in the sample was 18 years. A number of 50 respondents agreed to participate in the experiment on a voluntary basis. However, the data components of 8 respondents were incomplete and had to be removed from the analysis. The final research sample consisted of $N = 42$ male participants with ages ranging from 19 to 44 and an average age of 26.7 (SD age = 6.5). Information concerning their license, driving experience and educational level was collected. On average, young drivers in our sample (18–25 years, $N = 23$) owned their license for 3.3 years (SD = 1.72) and drove about 177.22 km per week. For adult drivers (26–45 years, $N = 19$), the average years of licensure was 13.47, and they drove about 384.84 km per week. While 56.5% of the young drivers owned their own vehicle, 89.5% of the adult drivers did. Of the young driver group, 82.6% were still enrolled as students. Meanwhile, from the adult driver group, 52.6% followed some kind of higher education program (i.e., professional bachelor, academic bachelor, and academic master).

3.2. Materials

3.2.1. Outcome Measure: Driving Anger Scale (DAS)

The propensity to become angry while driving was measured using the 14-item short form of the DAS, which has been shown to be comparable to the long DAS scale (33 items) [21]. Items describe potentially anger-provoking scenarios that might occur while someone is driving. Respondents rate each item to the degree to which the situation would anger them using a five-point Likert scale (1 = "not at all" to 5 = "very much"). Four out of six subscales inquire about the degree of anger triggered by other drivers' behaviour [59]. These subscales are: (1) hostile gestures (e.g., "others make an obscene gesture"), (2) illegal driving (e.g., "others going over the speed limit"), (3) slow driving (e.g., "slow driver does not pull over to let others by") and (4) discourtesy (e.g., "someone cuts you off"). Two out of the six subscales inquire about anger triggered by circumstantial blame, i.e., (5) police presence (e.g., "officer pulls you over") and (6) traffic obstructions

(e.g., "stuck in a traffic jam"). Previous research has revealed the short version of the DAS to be reliable with a Cronbach's alpha of $\alpha = 0.80$ and correlations of r = 0.95 with the long DAS scale [21,60].

3.2.2. Reactive–Proactive Questionnaire (RPQ)

The RPQ was developed by Raine et al. [36] to measure self-reported levels of reactive and proactive aggression. The questionnaire consisted of 23 items representing two sub-scales: 11 items measure reactive aggression, and 12 measure proactive aggression. The items were generated based on both teacher-rating measures and conceptual and theoretical literature of reactive and proactive aggression [36]. Participants were asked to assess how often a certain situation applied to them on a three-point scale: 0 (never), 1 (sometimes) and 2 (often). Example questions related to reactive aggression were: "Yelled at others when they have annoyed you" and "Reacted angrily when provoked by others". Examples related to proactive aggression were: "Had fights with others to show who was on top" and "Vandalized something for fun" [36]. In this study, the Dutch version of the RPQ was applied [61]. The internal consistency for the two subscales and the total aggression scale were high, with a Cronbach's alpha for reactive aggression of $\alpha = 0.83$, $\alpha = 0.87$ for proactive and $\alpha = 0.91$ for total aggression [61].

3.2.3. Emotional Stroop Task (EST)

The EST is a variant of the original Colour-word Stroop Task developed by Stroop [62] but differs from the original version as the EST uses coloured words with emotional connotation instead of words describing a colour [63]. Over the years, a large spectrum of studies applied the EST to test participants' reaction to emotional words that can be adjusted to the concept or pathology under study [64]. The EST applied in this study was designed with e-prime software and measures an attentional bias for aggressive stimuli, or the tendency to get distracted by aggressive stimuli. Participants had to indicate the colour of neutral words (e.g., "lamp", "floor", "pencil"), negative words (e.g., "dirty", "scary", "lost"), positive words (e.g., "fun", "smile", "peace") and aggression-related words (e.g., "conflict", "enemy", "hostile") which were presented in four different colours (red, yellow, green, and blue) on a computer screen. It was required to press the colour-corresponding response keys on a keyboard as quickly as possible using the index and middle fingers of the left and right hand. For this purpose, stickers representing the word colour were placed on the keys 'y, u, i, o' on the keyboard. The EST consisted of four blocks of 20 randomized words, preceded by a practice block of 8 words. The task has 88 trials in total, taking 10 min to complete. Delays in reaction times are expected to represent emotional interference when reading aggression-related words that can be perceived as threatening [28]. This delay in reaction time when reading aggression-related words was used as an EST-variable and entered into the analysis.

3.2.4. Single Target Implicit Association Task (ST-IAT)

The Single Target Implicit Association Test (ST-IAT), an adapted version of the IAT, was developed by Karpinski & Steinman [65] and uses a single attitude object to measure the strength of evaluative associations. Importantly, the ST-IAT reduces the arbitrary influence of a contrasting concept in the evaluation of a target category [66]. The current study included an idiographic version of the ST-IAT that replicated the test procedure applied by Brugman et al. [28]. Research has shown that this approach assesses self-related associations to a stronger degree, compared to the use of generic stimuli [67]. This version of the ST-IAT was designed with e-prime software and measured the association between the self and aggression by sorting aggressive words according to categories [28]. Words were presented in the middle of a computer screen, belonging either to the target category or to one of the two attribute categories that were shown in the upper corners of the screen. The target category was an idiosyncratic operationalized "I" (for example, participant's first name, birthday, etc.), and the attribute categories were "aggressive" (with aggressive

verbs such as abuse, attack, etc.) versus "peaceful" (with peaceful verbs such as cooperate, contribute and others). The participants had to categorize these words into the correct category as fast as possible by pushing the left or right response key on a keyboard. The IAT consisted of five blocks, with three and five being the test blocks. A simple categorization task was added in the first two blocks, followed by binary categorization tasks in the next three blocks. In total, the task comprised 138 trials, lasting for 16 min. The first block consisted of six trials where participants were presented with words related to themselves (e.g., name, age, address), which they had to attribute to the label "I," which was shown on the right corner of the screen by pressing the right key. The second block consisted of 24 trials, where participants were presented with verbs that either referred to the label "peaceful" (e.g., peaceful, contribute) in the upper left corner or "aggressive" (e.g., attack, abuse) in the upper right corner of the screen. The participants had to categorize the displayed verbs by pressing the corresponding key on the keyboard. The third block consisted of 48 trials where the labels of the previous blocks remained visible in the task, and the category "I" was added under the label "aggressive" in the upper right corner of the screen. Participants were now confronted with both verbs and words related to themselves and had to categorize these according to the labels. The fourth block consisted of 12 trials where the label "I" was shifted to the left upper corner, and the other labels were removed. Participants had to sort the displayed words related to the self by pressing the left key. The fifth block consisted again of 48 trials, where the label "I" remained in the upper left corner and the label "peaceful" was added underneath. The label "aggressive" was added to the upper right corner of the screen. In the same manner, participants had to sort the displayed verbs and words related to the self to each category. The ST-IAT effect was derived from the d-score, which was measured by comparing the mean reaction time during the test block with aggressive stimuli versus the mean reaction time during the test blocks with peaceful stimuli. A positive d-score indicates a stronger association between the self and aggression compared to the self and peaceful. A negative d-score indicates a stronger association between the self and peaceful, and a d-score of zero indicates no bias [28]. This d-score was used as ST-IAT variable and entered into the analysis.

3.3. Procedures

The experiment consisted of two parts. In part 1, participants who agreed to participate in the experiment received online questionnaires one week prior to their appointments. Each participant had to fill in the RPQ questionnaire and answered questions related to driving anger and demographics. After one week, the computer-based assessments (i.e., ST-IAT and EST) were conducted during part 2 of the experiment at the Transportation Research Institute (IMOB) in Diepenbeek, Belgium. The participants received general information about the study and had to sign a consent form before starting the tests. The tasks were counterbalanced among all participants. Once the experiment was completed, the participants received a reimbursement of 20 euro in gift vouchers.

3.4. Statistical Analysis

Descriptive statistics were calculated to get an overview of the data, to create an understanding of the drivers' sample, and to check for missing values. The identified missing values were replaced with the average score for this variable to complete the dataset. Cronbach's alpha showed high internal consistency among the questionnaire items resulting in a coefficient of $\alpha c = 0.78$ for the DAS, $\alpha c = 0.85$ for the construct of RPQ reactive aggression and $\alpha c = 0.80$ for RPQ proactive aggression. All independent variables were centred before conducting the analysis to avoid collinearity effects.

This study is the first in its kind to explore the associations of explicit and implicit measures related to reactive and proactive aggression with trait driving anger under the aspect of age. Therefore, a two-tailed multiple linear regression analysis was conducted to investigate the relationship between trait driving anger and the covariates RPQ-reactive, RPQ-proactive, ST-IAT, EST and age. The regression analysis was conducted at a 90%

confidence level ($\alpha = 0.10$) in order to detect possible effects on a pilot study scale. Despite the fact that a confidence interval (CI) of 95% is more desirable, a CI of 90% is still frequently applied and have also been applied in the field of implicit tests or driving anger using correlational study designs [68–71]. To explore the research questions based on previous research and theory, RPQ-reactive, RPQ-proactive, the EST, the ST-IAT and age, as well as interactions between age and these variables, were entered into the regression model to investigate significant effects and interactions with respect to driving anger. Considering the increased number of covariates, the sample size was bootstrapped before regression to improve the robustness of the significance tests [72]. More specifically, we have applied a bias-corrected and accelerated 90% confidence interval (BCa 90% CI) bootstrapping method around the effects as it was recommended by Puth et al. [73] who have compared the performance of various bootstrapping methods. This bootstrap method delivered the best results in correcting for skewness as well as biases in the sample distribution. The authors highlighted that sample sizes of $n > 30$ are required to have a normal sampling distribution for bootstrapping purposes [73].

Moreover, we were specifically interested in the indirect interaction effects of age. To begin with, a mediation analysis following Baron & Kenny's [74] method was applied to make sure to rule out a causal relationship between the covariates. Afterwards, we have applied Hayes' PROCESS moderation model 1 for correlational research designs and bootstrapped the dataset 1000 times as it was recommended by Ismay & Kim [75] and Field [76]. The Preacher and Hayes' method has already been used to study the concept of trait driving anger, allowing a conditional process analysis (using OLS regression-based path analysis) to understand the conditional nature of correlations (see for example, [77–79]). Any significant interaction effects from the bootstrap regression model were then assessed with a simple slope analysis using Hayes' PROCESS macro in SPSS [80]. Significant interaction effects of age must be controlled for any other significant main effects; hence, such main effects were added as covariates. Also, for a meaningful interpretation of the interaction slope, the continuous age variable is displayed according to the two age categories as defined in the literature: young male drivers ranging from 19–25 years of age ($N = 24$) and adult male drivers with an age > 25 years ($N = 18$).

4. Results

An overview of the descriptive results for the dependent variable driving anger and the independent variables (before they were mean-centred) is displayed in Table 1.

Table 1. Descriptive statistics of the main variables.

Variables	Mean	S.D.	Minimum	Maximum	*N*
Driving anger	32.26	6.93	17	47	42
RPQ-Reactive	18.29	3.15	13	26	42
RPQ-Proactive	13.40	1.61	12	18	42
EST	−35.13	48.25	−129.32	59.54	42
ST-IAT	−0.30	0.36	−1.16	0.70	42
Age	26.74	6.52	19	44	42

Note: RPQ-Reactive = reactive aggression as measured by the RPQ, RPQ-proactive = proactive aggression as measured by the RPQ, EST = Emotional Stroop Task, ST-IAT = self-aggression association.

A bootstrapped simple regression analysis was conducted and the results of the bootstrapped simple regression model for driving anger is presented in Table 2. The model showed high explanatory power ($R^2 = 0.51$) with more than 50% of the variance explained by all variables in the model (including interactions with age). The regression model and coefficients were bootstrapped to evaluate the resampled effects of the entered covariates. The bootstrap distribution can indicate how close the sample estimates are to the true distribution and provide the bias, standard errors and confidence intervals (CI). Based on the bootstrap distribution an increased bias was estimated and the sample estimate was corrected and accelerated. To confirm model validity, independence of residuals

was analysed. The Durbin–Watson statistic confirmed that there is no autocorrelation of residuals (Durbin-Watson value = 2.56 > 2).

Table 2 reveals that the RPQ-reactive aggression was a significant covariate of driving anger under $\alpha < 0.01$. Also, the ST-IAT was a significant negative predictor of trait driving anger at $\alpha < 0.01$, meaning that lower levels of a self-association with aggression were associated with higher levels of trait driving anger. Specifically, the self-reported RPQ-reactive aggression score significantly related to increased self-reported trait driving anger scores, (B = 1.65, F (9,32) = 3.68, $p < 0.01$).

On the other hand, the ST-IAT score (self-aggression association) significantly related to the self-reported trait driving anger scores within 90% CI, (B = −4.98, F (9,32) = 3.68, $p = 0.08$). This implies that higher values of the explicit measure of reactive aggression are significantly related to trait driving anger, and the higher values of the implicit measure of an aggressive self-association are significantly related to lower values of trait driving anger.

Moreover, there was a significant interaction effect within 90% CI, meaning that the effect of proactive aggression on DAS depends on the level of age (moderator). Therefore, the significant interaction effect of age as moderator on the relationship between RPQproactive aggression and trait driving anger was further investigated (B = 0.25, F (9,32) = 3.68, $p = 0.09$). Figure 1 illustrates the direction of this interaction effect (e.g., simple slope analysis), revealing that for young male drivers (aged 18–25 years), higher levels of proactive aggression are significantly related to lower levels of trait driving anger (b = −2.48, t (42) = −2.57, $p = 0.01$), whereas higher levels of proactive aggression in adult male drivers are insignificantly related to higher levels of trait driving anger (b = −0.55, t (42) = 0.54, $p = 0.59$).
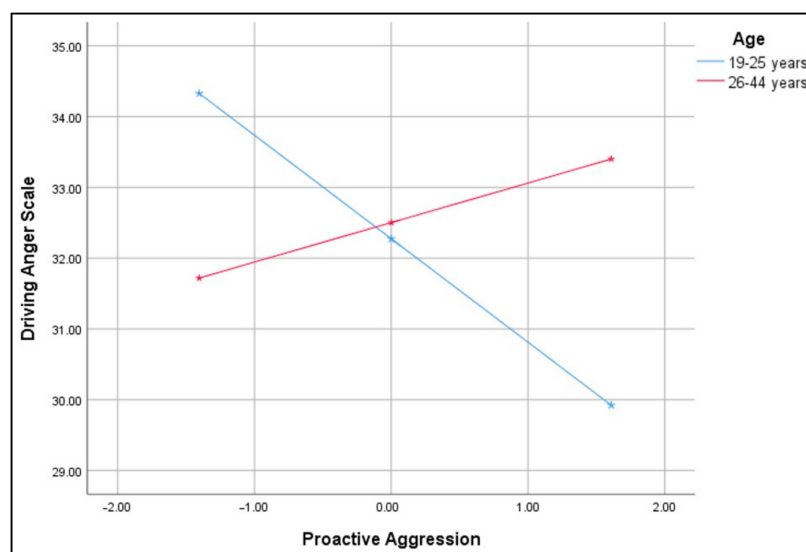
Figure 1. Slope regression lines for the interaction effect of age on the relationship between proactive aggression and trait driving anger, comparing young and adult drivers.

Table 2. Simple bootstrap regression model and coefficients for trait driving anger.

| Model | R | R2 | Adjusted R2 | S.E. | BCa 90% CI for B = 1000 | | | | | Durbin-Watson | Bias |
					R2 Change	F Change	df1	df2	*p*-Value		
	0.71	0.51	0.37	5.49	0.51	3.68	9	32	0.001 **	2.56	−0.91

| Variables | B | Bias | S.E. | *p*-Value | BCa 90% CI | |
					Lower	Upper
Constant	32.40	−0.03	0.96	0.001	30.86	33.84
RPQReactive	1.65	0.01	0.50	<0.01 **	0.93	2.49
RPQProactive	−0.67	−0.07	0.82	0.32	−1.93	0.33
EST	0.03	0.00	0.023	0.18	−0.01	0.08
ST-IAT	−4.98	−0.49	3.20	0.08 *	−8.95	−1.80

Table 2. *Cont.*

Model	R	R2	Adjusted R2	S.E.	BCa 90% CI for B = 1000					Durbin-Watson	Bias
					R2 Change	F Change	df1	df2	*p*-Value		
	0.71	0.51	0.37	5.49	0.51	3.68	9	32	0.001 **	2.56	−0.91

Variables	B	Bias	S.E.	*p*-Value	BCa 90% CI	
					Lower	Upper
Age	0.18	−0.04	0.18	0.24	−0.07	0.33
RPQReactive* Age	−0.04	0.01	0.10	0.71	−0.19	0.17
RPQProactive * Age	0.25	−0.00	0.19	0.09 *	−0.13	0.55
EST * Age	−0.00	0.00	0.01	0.87	−0.01	0.01
ST-IAT * Age	−0.11	−0.04	0.66	0.85	−0.96	0.71

Note: 1000 bootstrapped sample and bias-corrected accelerated CI. * Significance level $\alpha < 0.10$ ** Significance level $\alpha < 0.01$. RPQ-Reactive = reactive aggression as measured by the RPQ, RPQ-proactive = proactive aggression as measured by the RPQ, EST = Emotional Stroop Task, ST-IAT = self-aggression association.

5. Discussion

The current pilot study aimed to determine whether explicit and implicit measures related to reactive and proactive aggression can be applied to trait driving anger research. To this end, we investigated the relationship between self-reported explicit reactive and proactive aggression and trait driving anger. Moreover, we investigated the relationship between trait driving anger and implicit measures that were already found to be correlates of reactive and proactive aggression. Specifically, we related the attentional bias related to reactive aggression, and the self-aggression association related to proactive aggression, to trait driving anger. Finally, the conditional effect of age on the relationship between reactive and proactive aggression, their cognitive correlates and driving anger was evaluated. In line with a number of authors claiming that reactive and proactive aggression are co-occurring dimensions with high inter-correlation [30–34] we found that both aggression types related differently to trait driving anger. Moreover, differences were found between implicit versus explicit measures and their relation to trait driving anger. Finally, age appeared to interact with the relationship between proactive aggression and trait driving anger.

5.1. Is Trait Driving Anger in Males Related to Age?

This study did not find any main effects of age on trait driving anger, which is consistent with past studies that either found no or very small age effects [14,81]. However, it contradicts with other studies showing that driving anger predominantly occurs among young drivers and declines with age because young drivers are found to lack the ability to cognitively control anger and have difficulties in restraining aggressive behaviours [13,82]. Furthermore, mainly young samples up to their early 20s showed no effect of age, or small effects, in previous studies including the DAS. At the same time, samples with larger age ranges showed more differences and greater effects [14]. Possibly, the lack of a main effect of age on trait driving anger in this study could still be ascribed to an inadequate inclusion of age ranges since we only included participants up to 45 years. Including an age range, e.g., also containing additional younger (<19 years) and adult drivers (>44 years), but also older drivers (>70 years), could have contributed to more significant results of age. Also, the age at which a licence can be obtained, and the circumstances in which (learner) young drivers are allowed to drive, can affect the age-anger relationship. For instance, young novice drivers can receive a licence at the age of 16, or even younger, in the U.S., whereas they would not be able to drive unrestricted until the age of 19 in other countries. Finally, the small sample size and dichotomous age measurement could have contributed to the fact that no age effect was found.

5.2. Is Trait Driving Anger in Males Related to Reactive Aggression, Proactive Aggression, or a Combination of Both Aggression Types, as Measured with Explicit Self-Report?

The results showed that reactive aggression and trait driving anger are related. Although it is not possible to draw any causal inferences from this study, the literature denotes common relationships of reactive aggression and (driving) trait anger that could be responsible for the relation found in this study. For instance, both have a common relationship with impulsiveness, hostility, sensation seeking and risk-taking, which is illustrated by findings in previous literature. To illustrate, the literature evidences reactive aggression to be related to increased impulsiveness, hyperactivity, anger, social anxiety and cognitive difficulties such as impairments in executive functioning, inadequate encoding and problem-solving processes and unusual perceptive experiences or references, and poor social adjustment [36,61]. Furthermore, drivers with high levels of reactive aggression are assumed to have deficits in self-regulation and effortful control [11,25]. In accordance, overestimation of importance and negative interpretations of a certain situation, together with little self-instructed thinking about adaptive coping strategies in order to neutralize feelings of anger, are also found in drivers with high trait driving anger [23]. Drivers that get angry about reckless driving behaviour could react aggressively in order to teach the other driver a lesson in traffic safety. Studies that included driving behaviour as an outcome variable confirm that drivers high in reactive aggression and driving anger are actually willing to violate traffic rules in order to release negative arousals and to punish the driving behaviour of a fellow driver [13,83].

Interestingly, the relation between reactive aggression and trait driving anger, combined with the lack of a relation between proactive aggression and trait driving anger, is in line with literature related to motivational underpinnings of trait driving anger. Veenstra et al. [11] described that differences in trait anger are partly based on biology, with the approach system being the neurophysiological system that is most involved in trait anger, compared to the avoidance system. Lobbestael et al. [84] measured the relation between reactive versus proactive aggression and behavioural approach- and avoidance-related tendencies. They found that reactive but not proactive aggression related to the behavioural approach, as measured with a joystick-controlled task including attack-related scenes. Therefore, approach motivation could play a role in the heightened anger and aggression that is displayed by high trait driving anger people. If this would be the case, it could entail that lowering approach motivation may lower state anger and displayed aggression in people with high trait anger [11]. However, the exact underlying mechanisms of the relation between reactive aggression and trait driving anger first need to be investigated in follow-up research, including approach motivation. Nevertheless, the results of this study show that reactive aggression is related to trait driving anger, in comparison to proactive aggression.

5.3. Is Trait Driving Anger in Males Related to Correlates of Reactive and Proactive Aggression, the Attentional Bias, and the Self-Aggression Association?

The results show that the self-aggression association bias, measured by the ST-IAT, negatively related to trait driving anger. The self-aggression association can be considered to reflect a bias in the memory retrieval of past aggressive behaviour, which is likely to be caused by a limited repertoire of mainly past aggressive responses stored in long-term memory [28]. However, findings show that the ST-IAT measure was related to lower levels of trait driving anger. As stated above, the ST-IAT correlated with proactive aggression in the study from Brugman et al. [28]. Proactive aggression is characterized by an instrumental or reward-oriented motivation that is not primarily associated with provocation, emotional arousal or anger. Previous studies revealed that proactively aggressive drivers do not become irritated or aroused when they see other drivers "drive fast, run a red light or a stop sign, or weave in and out of traffic to pass quicker" (p. 1076 [13]). Considering this, the absence of a positive relationship between a correlate of proactive aggressions and trait driving anger seems plausible. Still, it does not explain why a negative relation was found between the ST-IAT and trait driving anger. The lack of any kind of relation would

be plausible as well. However, this result is in line with previous psychological research targeting proactive aggression. For instance, Jambon et al. [85] found that anger reactivity, represented by self-reported anger elicited by social conflicts, related to higher levels of proactive aggression in male children of eight years, but this was not found for the female children. Although they didn't target trait anger, Bobadilla et al. [86] established that proactive aggression reported by men also related to low reactivity to anxiety/punishment, which again was not found for females in a study using a student sample. Probably due to a blunted emotional reaction to anger-evoking situations, higher levels of proactive aggression allow young males to more easily use aggression in order to obtain their goals [86]. Indeed, reduced emotional reactivity could point to a lack of interest in others' distress [87]. This reasoning is supported by theory and evidence that proactive aggression is related to hypo-reactivity of the autonomic nervous system [87,88]. Puhalla et al. [88] found indications to support this hypothesis in a study with college students, including both males and females, although emotion regulation may have played a mediating role. Follow-up studies are thus required to further disentangle the relationship found in this pilot study.

In contrast to the self-aggression association bias, the attentional bias towards aggressive stimuli, as measured by the EST, did not significantly relate to trait driving anger. This is not in line with previous research. For instance, studies showed that people with high trait anger paid more attention to hostile stimuli. In a similar vein, the hostile attribution bias, or the likelihood to interpret the motives of others in ambiguous social events as provocative instead of harmless or accidental, also relates to reactive and not proactive aggression [12]. The lack of a relation between the EST and trait driving anger in the current study could be related to the correspondence principle as first described by Ajzen & Fishbein [89]. This principle describes how attitudes relate better to behaviour in case of a correspondence between the attitude object and the criterion/behaviour in question in terms of the level of generality or specificity [47,48,51,90]. Indeed, correlations between explicit and implicit measures were found to be higher with matching rather than mismatching contents [48]. Although the EST does not measure attitudes, a similar process could explain the absence of a relationship between the attentional bias towards aggression and trait driving anger. Indeed, differences between explicit and implicit measures can be related to structural task differences. For instance, as trait driving anger is distinct from trait anger, the use of traffic-related stimuli in the EST could raise the likelihood of a significant relationship between the EST and trait driving anger. Other structural differences relate to differences in the type of response, i.e., rating scales for explicit measures and response latencies or error rates for implicit measures. Moreover, implicit measures often are constrained by time limitations, which is generally not the case for explicit measures. One solution could be to also restrict the time participants have to respond to the explicit measures [48]. Finally, Gawronski et al. [91] reported that scores on implicit measures are temporally more unstable than scores on related explicit measures. Therefore, the current absence of a relation between the EST and the DAS could also be attributed to a temporal effect. However, the ST-IAT did relate to self-reported trait driving anger, in contrast to the EST. Possibly, the ST-IAT was a better fit, i.e., corresponded more closely to the DAS as an outcome measure, while the EST would relate better to an outcome measure representing an attentional or behavioural outcome. Further longitudinal research with the inclusion of additional measurement points in time and adapted task designs should be executed to determine whether the attentional bias towards aggression is indeed not related to trait driving anger. In any case, the absence of an effect for the EST does not entail that implicit measures cannot be useful in the field of trait driving anger, especially since the ST-IAT did show a significant effect. However, it is clear that more research is required before any firm conclusions can be drawn about the usefulness of the specific biases included in the current study with respect to trait driving anger.

5.4. Does the Relationship between Trait Driving Anger and the Explicit or Implicit Measures Related to Reactive and Proactive Aggression Differ per Age Category?

Age did not interact with the relationships between trait driving anger and reactive aggression or trait driving anger and the EST. This is not in line with Brugman et al. [28] who reported that reactive aggression decreased with age as compared to proactive aggression, which was more stable. Their study, however, included a broader age range, i.e., 18–54 years. The results did show a significant interaction effect of age on the relationship between self-reported proactive aggression and trait driving anger, albeit not between the ST-IAT and trait driving anger. The significant interaction effect found indicated that young male drivers (aged 18–25 years) reporting higher levels of proactive aggression, also reported lower levels of driving anger and vice versa. This coincides with the results found for the ST-IAT, and thus could relate to the instrumental nature of proactive aggression and accompanying blunted emotional responses. Yet, in contrast with the ST-IAT relation to trait driving anger, the negative relation between proactive aggression and trait driving anger was not found for adult drivers over 25 years of age. Instead, an insignificant positive relationship was found between reported proactive aggression and driving anger in adult male drivers. This indicates that, despite the insignificance, older people reporting high levels of proactive aggression also reported higher levels of trait driving anger and vice versa. Research has shown that self-regulation increases with age, which makes adult drivers more able to down-regulate their hostile thoughts as well as to modulate their urge to seek rewards [92] (i.e., the main driver behind proactive aggression). In support, examples from Björklund's [13] survey show that older drivers report less anger than younger drivers at progress impeded (i.e., proactive aggression) and direct hostility (reactive aggression). There could be another explanation as to why the negative relation between proactive aggression and trait driving anger is not found for the older adult sample in this study. It is possible that a self-report bias [93] influenced the results in the sense that drivers above 25 years old might have been reluctant to admit they display proactively aggressive behaviours during driving. Nevertheless, these are all assumptions that await further empirical validation. Further research will be necessary to draw any firm conclusions with respect to the relation between proactive aggression and age, especially due to the small sample size and dichotomous measurement of age.

6. Limitations and Avenues for Future Research

First, it has to be considered that the significance level of this study was $p < 0.1$. Although this is a commonly used significance level, researchers often oppose to a divergence of the $p < 0.05$ level. For the current purposes, however, this is an acceptable significance level since this was a first pilot study, including a smaller sample size, aimed to provide an exploration of relationships found in the research domain of aggression. This study already reveals several interesting results that require further exploration to replicate and extend the results. These follow-up studies should use bigger sample sizes in order to be able to increase statistical power and employ stricter significance levels. Second, implicit measures were confronted with many criticisms in recent years. The IAT, for instance, was described as a poor predictor of behaviour [51,94]. Indeed, previous literature has highlighted that the IAT might also measure attitude-unrelated constructs such as salience of attributes [95] and/or cultural knowledge [53,96]. However, the current study included an idiographic ST-IAT, measuring direct associations between the self-concept and aggression. As such, the personalized approach reduces the influence of extrapersonal associations [96]. Furthermore, Brownstein et al. [51] argue that implicit cognitive bias research still comes with great potential, despite the existing challenges and room for improvement. Although it goes beyond the scope of the current manuscript to describe all the criticism related to implicit measurements, we refer to Brownstein et al. [47,51] and Gawronski & De Houwer [48] for some relevant recent overviews. Third, it could be useful to investigate additional cognitive biases. For instance, the hostile attribution bias, or the tendency to interpret motives of others in ambiguous social events as provocative [44,97], which was already found to relate

to the experience of anger [98] and reactive aggression [12]. Together with the attentional bias towards aggression, the hostile attribution bias represents the early stages of social information processing as described by the SIP. Therefore, it would be interesting in future research to compare the results from the EST with results from the hostile attribution bias. Fourth, reaction time measures do not only represent cognitive processes under investigation, such as selective attention, but also a combination of evaluative, decision and motor processes [99] Neurological research could be useful to disentangle cognitive processes related to biases in individuals that display different levels of aggression or anger [100]. For instance, event-related potentials (ERP) research allows for a detailed assessment of the time course leading up to social cognitive mechanisms. Fifth, future studies could also investigate the impact of additional variables such as self-regulation and related concepts (e.g., working memory [15], effortful control [101]) and anger rumination [101,102], as well as relevant aggression-related personality traits, like anti-social personality traits [103,104]. Sixth, we have used an explicit self-report questionnaire to measure trait driving anger. Future research could measure driving anger via actual observation of the drivers, for example, during field studies or in a driving simulator study, which would allow for an investigation into aggressive driving behaviour in a safe and controlled environment. Actual observation would also allow the addition of provocations in a driving-context. Deffenbacher et al. [24] stated that trait driving anger is context-specific and that a driver's disposition to anger interacts with a provocation on the road. Therefore, comparing driving situations with and without provocation for drivers with low and high trait driving anger, combined with explicit and implicit measures related to reactive and proactive aggression, would be an interesting avenue for future research. For instance, to determine if the negative relation between proactive aggression or the ST-IAT with driving anger can be replicated, and whether this relation differs depending on the inclusion of provocation or not. In support, Brugman et al. [28] already provided a discussion of different relations between the ST-IAT and proactive aggression that could be caused by the inclusion of provocation in studies or the lack thereof.

The current study was the first to successfully use explicit measures of reactive and proactive aggression conjointly with implicit measures of related cognitive biases in a sample of males. One final promising avenue relates to specific target groups. For instance, although we had good reasons for targeting (young) male drivers, we are not able to generalize the results to other groups such as female or older drivers. To enhance the generalizability of the results, future studies could include a more diverse sample based on gender and age, but also based on other potentially relevant factors such as racial/ethnic background or socioeconomic status. As another example, we focused on neurotypical drivers, but a design with implicit measures could also be useful in studies including people with, for instance, Attention Deficit Hyperactivity disorder (ADHD) and Autism Spectrum Disorder (ASD). First, ADHD is characterized by inattention, impulsiveness and hyperactivity [105], but also has been related to reactive emotions, such as aggression and lack of emotional control [106], and increased likelihood of risky driving among males [107–109]. Moreover, young male drivers in the state of Qatar reporting higher hyperactivity-impulsivity traits were significantly more likely to also report ordinary violations, errors, lapses and aggressive violations. Furthermore, previous research found a link between reactive aggression and hyperactivity and impulsivity [35]. Second, ASD refers to "a neurodevelopmental disorder characterized by impairments in social interaction and communication, as well as repetitive behaviours and restricted interests" [110]. Similar to ADHD, ASD relates to difficulties in emotion regulation. These regulatory difficulties can be expressed in outbursts, self-injury or aggression, among others [111]. In addition, some characteristics associated with ASD, e.g., possible limitations in the planning and execution of actions, may interfere with driving, which could contribute to apprehensive driving [112]. Therefore, the identification of driving apprehension could enable the tailoring of driving lessons to the needs of novice drivers with ASD, reducing apprehensive driving. However, preliminary research already indicated that one must be cautious in the interpretation of

self-report measures in adolescents with ASD [113], which could be related to elevated levels of alexithymia (i.e., problematic identification and description of emotions) [111]. Considering the above, it could be advised to use implicit measures in combination with explicit measures to assess cognitive biases related to driver aggression, anger or anxiety in specific groups such as drivers with ADHD and ASD.

7. Practical Implications

From a practical point of view, the results of this paper imply how safety measures aiming at driving anger could best be tailored. As stated in the introduction, a combination of explicit and implicit tasks could be useful to assess a potential tendency for driving anger and aggression among male drivers. The distinction between reactive and proactive aggression additionally impacts assessment [41], which could already be done in the early stages of driving education in order to allow for timely intervention and remediation. Related to the included cognitive biases, the current results only indicated the self-aggression association (i.e., ST-IAT) as a possible candidate for assessment purposes. However, more research is necessary with respect to the attentional bias (i.e., EST). Moreover, as mentioned above, the hostile attribution bias might be a good candidate for the assessment of trait driving anger. Albeit preliminary, the current pilot study also allows us to briefly speculate about implications for interventions with respect to driving anger (i.e., for a recent review of interventions for driving anger, we refer to [114]). First, the distinction between reactive and proactive aggression not only comes with implications for assessment but also for treatment and intervention [41]. The relation between reactive aggression and trait driving anger suggests that targeting reactive aggression in an intervention could be useful for those with high trait driving anger, for instance, by including affect regulation or positive mood induction [41]. The inverse relation between proactive aggression, and its correlate, with trait driving anger, additionally shows that (young) male drivers could benefit from interventions that, for instance, increase empathy and perspective taking [41]. Second, as mentioned in the introduction, if the presence of cognitive biases can be related to increased anger and aggression, a reduction of attention and interpretation related biases may lead to decreasing tendencies towards anger and aggression [12,40]. Related to reactive and proactive aggression, Van Bockstaele et al. [97] included the hostile attribution bias as a target in bias modification training and found support for the usefulness of cognitive bias modification to reduce aggression. More in detail, participants were presented with ambiguously provocative social situations, and subsequently trained to interpret these situations in a more benign manner. Not only did the training increase the tendency to reduce the presence of a hostile attribution bias, but also led to decreased reactive but not proactive self-reported aggression compared with a control group [97]. The latter is in line with the hypotheses from the SIP model, especially relating reactive aggression to early interpretation biases. In addition, related to the usefulness of implicit measures for ASD and/or ADHD, Schmidt & Vereenooghe [115] conducted a systematic review on the available evidence for CBM in children and adults with neurodevelopmental disorders (NDD). Although few studies actually targeted NDD, preliminary evidence for its usefulness was found for the feasibility of CBM in children and young people with mild intellectual disability, ASD or ADHD [115]. Policymakers are advised to take the implications of this study into account to achieve a more sustainable behavioural change that benefits road safety. Nevertheless, due to the exploratory nature of our study, more research will be necessary to draw firm conclusions concerning assessment and/or intervention purposes, leading to future improvements in road safety policies.

8. Conclusions

From the current pilot study, it can be concluded that self-reported reactive aggression was positively related to trait driving anger in male drivers, possibly increasing these drivers' propensity to display aggression on the roads. In contrast, a self-aggression association with aggressive stimuli (ST-IAT) was negatively related to trait driving anger in

male drivers. Similarly, self-reported proactive aggression was negatively related to driving anger, with higher levels of proactive aggression relating to lower levels of trait driving anger, but only in young male drivers. Therefore, the implicit measurement of cognitive biases associated with reactive and proactive aggression, combined with explicit measures of reactive and proactive aggression, are useful to investigate underlying mechanisms of trait driving anger. Further research is necessary to replicate and extend these preliminary results, preferably using a causal design, in order to allow for firm conclusions with respect to assessment and intervention.

References

1. Techer, F.; Jallais, C.; Corson, Y.; Moreau, F.; Ndiaye, D.; Piechnick, B.; Fort, A. Attention and driving performance modulations due to anger state: Contribution of electroencephalographic data. *Neurosci. Lett.* **2017**, *636*, 134–139. [CrossRef]
2. Foundation for Traffic Safety, AAA. Prevalence of Self-Reported Aggressive Driving Behavior: United States, 2014. 2016. Available online: https://www.aaafoundation.org/sites/default/files/PrevalenceofAggressiveDriving2014.pdf (accessed on 1 August 2016).
3. Haupt U.S. News & World Report. 2012. Available online: https://health.usnews.com/health-news/articles/2012/08/30/how-to-control-road-rage (accessed on 9 September 2019).
4. Biassoni, F.; Balzarotti, S.; Giamporcaro, M.; Ciceri, R. Hot or cold anger? Verbal and vocal expression of anger while driving in a simulated anger-provoking scenario. *SAGE Open* **2016**, *6*. [CrossRef]
5. Wickens, C.M.; Mann, R.E.; Ialomiteanu, A.R.; Stoduto, G. Do driver anger and aggression contribute to the odds of a crash? A population-level analysis. *Transp. Res. Part F Traffic Psychol. Behav.* **2016**, *42*, 389–399. [CrossRef]
6. Zhang, T.; Chan, A.H.S.; Zhang, W. Dimensions of driving anger and their relationships with aberrant driving. *Accid. Anal. Prev.* **2015**, *81*, 124–133. [CrossRef] [PubMed]
7. Coie, J.D.; Dodge, K.A. Aggression and antisocial behavior. In *Handbook of Child Psychology: Social, Emotional, and Personality Development*; Damon, W., Eisenberg, N., Eds.; John Wiley & Sons Inc: Hoboken, NJ, USA, 1998; pp. 779–862.
8. Foundation for Traffic Safety, AAA. 2019 Traffic Safety Culture Index. June 2020. Available online: https://aaafoundation.org/2019-traffic-safety-culture-index/ (accessed on 22 January 2021).
9. Foundation for Traffic Safety, AAA. 2016 Traffic Safety Culture Index. February 2017. Available online: https://aaafoundation.org/2016-traffic-safety-culture-index/ (accessed on 22 January 2021).
10. Foundation for Traffic Safety, AAA. 2018 Traffic Safety Culture Index. June 2019. Available online: https://aaafoundation.org/2018-traffic-safety-culture-index/ (accessed on 22 January 2021).
11. Björklund, G.M. Driver irritation and aggressive behaviour. *Accid. Anal. Prev.* **2008**, *40*, 1069–1077. [CrossRef]
12. Deffenbacher, J.L.; Stephens, A.N.; Sullman, M.J.M. Driving anger as a psychological construct: Twenty years of research using the Driving Anger Scale. *Transp. Res. Part F Traffic Psychol. Behav.* **2016**, *42*, 236–247. [CrossRef]
13. Ross, V.; Jongen, E.M.M.; Brijs, T.; Ruiter, R.A.C.; Brijs, K.; Wets, G. The relation between cognitive control and risky driving in young novice drivers. *Appl. Neuropsychol. Adult* **2015**, *22*, 61–72. [CrossRef]

14. De Luca, C.; Leventer, R. Developmental trajectories of executive functions across the lifespan. In *Executive Functions and the Frontal Lobes*; Taylor & Francis Group: New York, NY, USA, 2008; pp. 23–56.

15. Glendon, I.A. Neuroscience and young drivers. In *Handbook of Traffic Psychology*; Elsevier/Academic Press: Amsterdam, The Netherlands, 2011; pp. 109–125.

16. Ross, V.; Jongen, E.M.; Wang, W.; Brijs, T.; Brijs, K.; Ruiter, R.A.; Wets, G. Investigating the influence of working memory capacity when driving behavior is combined with cognitive load: An LCT study of young novice drivers. *Accid. Anal. Prev.* **2014**, *62*, 377–387. [CrossRef]

17. Rappaport, N.; Thomas, C. Recent research findings on aggressive and violent behavior in youth: Implications for clinical assessment and intervention. *J. Adolesc. Health* **2004**, *35*, 260–277. [CrossRef]

18. Veenstra, L.; Bushman, B.J.; Koole, S.L. The facts on the furious: A brief review of the psychology of trait anger. *Curr. Opin. Psychol.* **2018**, *19*, 98–103. [CrossRef]

19. Wilkowski, B.M.; Robinson, M.D. The cognitive basis of trait anger and reactive aggression: An integrative analysis. *Personal. Soc. Psychol. Rev.* **2008**, *12*, 3–21. [CrossRef] [PubMed]

20. Blankenship, K.L.; Nesbit, S.M. Driving stimuli increases accessibility of aggression-related concepts in "angry" drivers. *Personal. Individ. Differ.* **2013**, *55*, 135–140. [CrossRef]

21. Deffenbacher, J.L.; Oetting, E.R.; Lynch, R.S. Development of a driving anger scale. *Psychol. Rep.* **1994**, *74*, 83–91. [CrossRef]

22. Deffenbacher, J.L.; Lynch, R.S.; Oetting, E.R. Yingling, D.A. Driving anger: Correlates and a test of state-trait theory. *Personal. Individ. Differ.* **2001**, *31*, 1321–1331. [CrossRef]

23. Deffenbacher, J.L.; Petrilli, R.T.; Lynch, R.S.; Oetting, E.R.; Swaim, R.C. The driver's angry thoughts questionnaire: A measure of angry cognitions when driving. *Cogn. Ther. Res.* **2003**, *27*, 383–402. [CrossRef]

24. Deffenbacher, J.L.; Deffenbacher, D.M.; Lynch, R.S.; Richards, T.L. Anger, aggression, and risky behavior: A comparison of high and low anger drivers. *Behav. Res. Ther.* **2003**, *41*, 701–718. [CrossRef]

25. Cui, L.; Colasante, T.; Malti, T.; Ribeaud, D.; Eisner, M.P. Dual trajectories of reactive and proactive aggression from mid-childhood to early adolescence: Relations to sensation seeking, risk taking, and moral reasoning. *J. Abnorm. Child Psychol.* **2016**, *44*, 663–675. [CrossRef]

26. Hubbard, J.A.; McAuliffe, M.D.; Morrow, M.T.; Romano, L.J. Reactive and proactive aggression in childhood and adolescence: Precursors, outcomes, processes, experiences, and measurement. *J. Personal.* **2010**, *78*, 95–118. [CrossRef] [PubMed]

27. Wilkowski, B.M.; Robinson, M.D. The anatomy of anger: An integrative cognitive model of trait anger and reactive aggression. *J. Personal.* **2010**, *78*, 9–38. [CrossRef]

28. Brugman, S.; Lobbestael, J.; Arntz, A.; Cima, M.; Schuhmann, T.; Dambacher, F.; Sack, A.T. Identifying cognitive predictors of reactive and proactive aggression. *Aggress. Behav.* **2015**, *41*, 51–64. [CrossRef]

29. Tuvblad, C.; Raine, A.; Zheng, M.; Baker, L.A. Genetic and environmental stability differs in reactive and proactive aggression. *Aggress. Behav.* **2009**, *35*, 437–452. [CrossRef]

30. Anderson, C.A.; Bushman, B.J. Human aggression. *Annu. Rev. Psychol.* **2002**, *53*. [CrossRef] [PubMed]

31. Bushman, B.J.; Anderson, C.A. Is it time to pull the plug on hostile versus instrumental aggression dichotomy? *Psychol. Rev.* **2001**, *108*, 273. [CrossRef]

32. Card, N.A.; Little, T.D. Proactive and reactive aggression in childhood and adolescence: A meta-analysis of differential relations with psychosocial adjustment. *Int. J. Behav. Dev.* **2006**, *30*, 466–480. [CrossRef]

33. Hubbard, J.A.; Smithmyer, C.M.; Ramsden, S.R.; Parker, E.H.; Flanagan, K.D.; Dearing, K.F.; Relyea, N.; Simons, R.F. Observational, physiological, and self–report measures of children's anger: Relations to reactive versus proactive aggression. *Child Dev.* **2002**, *73*, 1101–1118. [CrossRef] [PubMed]

34. Poulin, F.; Boivin, M. Reactive and proactive aggression: Evidence of a two-factor model. *Psychol. Assess.* **2000**, *12*, 115. [CrossRef]

35. Cima, M.; Raine, A. Distinct characteristics of psychopathy relate to different subtypes of aggression. *Personal. Individ. Differ.* **2009**, *47*, 835–840. [CrossRef]

36. Raine, A.; Dodge, K.; Loeber, R.; Gatzke-Kopp, L.; Lynam, D.; Reynolds, C.; Stouthamer-Loeber, M.; Liu, J. The reactive-proactive aggression questionnaire: Differential correlates of reactive and proactive aggression in adolescent boys. *Aggress. Behav.* **2006**, *32*, 159–171. [CrossRef]

37. Berdoulat, E.; Vavassori, D.; Sastre, M.T.M. Driving anger, emotional and instrumental aggressiveness, and impulsiveness in the prediction of aggressive and transgressive driving. *Accid. Anal. Prev.* **2013**, *50*, 758–767. [CrossRef] [PubMed]

38. Novaco, R.W. Cognitive–behavioral factors and anger in the occurrence of aggression and violence. In *The Wiley Handbook of Violence And Aggression*; Wiley Online Library: Hoboken, NJ, USA, 2017; pp. 1–13.

39. Crick, N.R.; Dodge, K.A. A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychol. Bull.* **1994**, *115*, 74. [CrossRef]

40. AlMoghrabi, N.; Huijding, J.; Mayer, B.; Franken, I.H. Gaze-contingent attention bias modification training and its effect on attention, interpretations, mood, and aggressive behavior. *Cogn. Ther. Res.* **2019**, *43*, 861–873. [CrossRef]

41. Miller, J.D.; Lynam, D.R. Reactive and proactive aggression: Similarities and differences. *Personal. Individ. Differ.* **2006**, *41*, 1469–1480. [CrossRef]

42. Crick, N.R.; Dodge, K.A. Social information-processing mechanisms in reactive and proactive aggression. *Child Dev.* **1996**, *67*, 993–1002. [CrossRef]

43. Shaffer, D.D.R. *Developmental Psychology: Childhood & Adolescence*, 6th ed.; Wadsworth Thomson Learning: Belmont, CA, USA, 2002.

44. Tuente, S.K.; Bogaerts, S.; Veling, W. Hostile attribution bias and aggression in adults—A systematic review. *Aggress. Violent Behav.* **2019**, *46*, 66–81. [CrossRef]

45. Walters, G.D. Measuring proactive and reactive criminal thinking with the PICT. *J. Interpers. Violence* **2007**, *22*, 371–385. [CrossRef]

46. Jones, E.B.; Sharpe, L. Cognitive bias modification: A review of meta-analyses. *J. Affect. Disord.* **2017**, *223*, 175–183. [CrossRef] [PubMed]

47. Brownstein, M.; Madva, A.; Gawronski, B. What do implicit measures measure? *Wiley Interdiscip. Rev. Cogn. Sci.* **2019**, *10*, e1501. [CrossRef]

48. Gawronski, B.; De Houwer, J. Implicit measures in social and personality psychology. In *Handbook of Research Methods in Social and Personality Psychology*, 2nd ed.; Cambridge University Press: New York, NY, USA, 2014.

49. Hahn, A.; Judd, C.M.; Hirsh, H.K.; Blair, I.V. Awareness of implicit attitudes. *J. Exp. Psychol. Gen.* **2014**, *143*, 1369. [CrossRef]

50. Fazio, R.H. Attitudes as object–evaluation associations of varying strength. *Soc. Cogn.* **2007**, *25*, 603–637. [CrossRef] [PubMed]

51. Brownstein, M.; Madva, A.; Gawronski, B. Understanding implicit bias: Putting the criticism into perspective. *Pac. Philos. Q.* **2019**, *101*, 276–307. [CrossRef]

52. Calanchini, J.; Sherman, J.W. Implicit attitudes reflect associative, non-associative, and non-attitudinal processes. *Soc. Personal. Psychol. Compass* **2013**, *7*, 654–667. [CrossRef]

53. Fiedler, K.; Messner, C.; Bluemke, M. Unresolved problems with the "I", the "A", and the "T": A logical and psychometric critique of the Implicit Association Test (IAT). *Eur. Rev. Soc. Psychol.* **2006**, *17*, 74–147. [CrossRef]

54. Zheng, T.; Qu, W.; Zhang, K.; Ge, Y. The relationship between attentional bias toward safety and driving behavior. *Accid. Anal. Prev.* **2016**, *96*, 22–28. [CrossRef]

55. Bıçaksız, P.; Harma, M.; Doğruyol, B.; Lajunen, T.; Özkan, T. Implicit evaluations about driving skills predicting driving performance. *Transp. Res. Part F Traffic Psychol. Behav.* **2018**, *54*, 357–366. [CrossRef]

56. Chai, J.; Qu, W.; Sun, X.Z.K.; Ge, Y. Negativity bias in dangerous drivers. *PLoS ONE* **2016**, *11*, e0147083. [CrossRef]

57. Martinussen, L.M.; Sømhovd, M.J.; Møller, M.; Siebler, F. A Go/No-go approach to uncovering implicit attitudes towards safe and risky driving. *Transp. Res. Part F Traffic Psychol. Behav.* **2015**, *30*, 74–83. [CrossRef]

58. Sani, S.R.H.; Tabibi, Z.; Fadardi, J.S.; Stavrinos, D. Aggression, emotional self-regulation, attentional bias, and cognitive inhibition predict risky driving behavior. *Accid. Anal. Prev.* **2017**, *109*, 78–88. [CrossRef]

59. Roidl, E.; Frehse, B.; Höger, R. Emotional states of drivers and the impact on speed, acceleration and traffic violations—A simulator study. *Accid. Anal. Prev.* **2014**, *70*, 282–292. [CrossRef] [PubMed]

60. Deffenbacher, J.L.; Huff, M.E.; Lynch, R.S.; Oetting, E.R.; Salvatore, N.F. Characteristics and treatment of high-anger drivers. *J. Couns. Psychol.* **2000**, *47*, 5–17. [CrossRef]

61. Cima, M.; Raine, A.; Meesters, C.; Popma, A. Validation of the dutch reactive proactive questionnaire (RPQ): Differential correlates of reactive and proactive aggression from childhood to adulthood. *Aggress. Behav.* **2013**, *39*, 99–113. [CrossRef]

62. Stroop, J.R. Studies of interference in serial verbal reactions. *J. Exp. Psychol.* **1935**, *18*, 643. [CrossRef]

63. Larsen, R.J.; Mercer, K.A.; Balota, D.A. Lexical characteristics of words used in emotional Stroop experiments. *Emotion* **2006**, *6*, 62. [CrossRef] [PubMed]

64. Williams, J.M.G.; Mathews, A.; MacLeod, C. The emotional Stroop task and psychopathology. *Psychol. Bull.* **1996**, *120*, 3. [CrossRef]

65. Karpinski, A.; Steinman, R.B. The single category implicit association test as a measure of implicit social cognition. *J. Personal. Soc. Psychol.* **2006**, *91*, 16. [CrossRef] [PubMed]

66. Bluemke, M.; Friese, M. Reliability and validity of the Single-Target IAT (ST-IAT): Assessing automatic affect towards multiple attitude objects. *Eur. J. Soc. Psychol.* **2008**, *38*, 977–997. [CrossRef]

67. Bluemke, M.; Friese, M. On the validity of idiographic and generic self-concept implicit association tests: A core-concept model. *Eur. J. Personal.* **2012**, *26*, 515–528. [CrossRef]

68. Hofmann, W.; Gawronski, B.; Gschwendner, T.; Le, H.; Schmitt, M. A meta-analysis on the correlation between the Implicit Association Test and explicit self-report measures. *Personal. Soc. Psychol. Bull.* **2005**, *31*, 1369–1385. [CrossRef]

69. Kam, C.D. Implicit attitudes, explicit choices: When subliminal priming predicts candidate preference. *Political Behav.* **2007**, *29*, 343–367. [CrossRef]

70. Li, F.; Yao, X.; Jiang, L.; Li, Y. Driving anger in China: Psychometric properties of the Driving Anger Scale (DAS) and its relationship with aggressive driving. *Personal. Individ. Differ.* **2014**, *68*, 130–135. [CrossRef]

71. Stephens, A.N.; Sullman, M.J.M. Development of a short form of the driving anger expression inventory. *Accid. Anal. Prev.* **2014**, *72*, 169–176. [CrossRef]

72. Hesterberg, T.; Monaghan, S.; Moore, D.S.; Clipson, A.; Epstein, R. Bootstrap methods and permutation tests. In *Companion Chapter 18 to the Practice of Business Statistics*; W. H. Freeman and Company: New York, NY, USA, 2003.

73. Puth, M.T.; Neuhäuser, M.; Ruxton, G.D. On the variety of methods for calculating confidence intervals by bootstrapping. *J. Anim. Ecol.* **2015**, *84*, 892–897. [CrossRef] [PubMed]

74. Baron, R.M.; Kenny, D.A. The moderator-mediator variable distinction in social psychological research. Conceptual, strategic, and statistical considerations. *J. Personal. Soc. Psychol.* **1986**, *51*, 1173–1182. [CrossRef]

75. Ismay, C.; Kim, A. *Statistical Inference via Data Science: A Modern Dive into R and the Tidyverse*; Chapman and Hall: New York, NY, USA; CRC: New York, NY, USA, 2020.

76. Field, A. *Discovering Statistics Using IBM SPSS Statistics: And Sex and Drugs and Rock 'n' Roll*, 4th ed.; Sage: London, UK, 2013.

77. Ge, Y.; Zhang, Q.; Zhao, W.; Zhang, K.; Qu, W. Effects of trait anger, driving anger, and driving experience on dangerous driving behavior: A moderated mediation analysis. *Aggress. Behav.* **2017**, *43*, 1–9. [CrossRef] [PubMed]

78. Edwards, B.D.; Warren, C.R.; Tubré, T.C.; Zyphur, M.J.; Hoffner-Prillaman, R. The validity of narcissism and driving anger in predicting aggressive driving in a sample of young drivers. *Hum. Perform.* **2013**, *26*, 191–210. [CrossRef]

79. Wong, Y.; Mahar, D.; Titchener, K. Driven by distraction: Investigating the effects of anxiety on driving performance using the Attentional Control Theory. *J. Risk Res.* **2014**, *9877*, 1–14. [CrossRef]

80. Hayes, A.F. Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. In *Methodology in the Social Sciences*; Guilford Press: New York, NY, USA, 2013.

81. Nesbit, S.M.; Conger, J.C.; Conger, A.J. A quantitative review of the relationship between anger and aggressive driving. *Aggress. Violent Behav.* **2007**, *12*, 156–176. [CrossRef]

82. Forward, S.E. An assessment of what motivates road violations. *Transp. Res. Part F Traffic Psychol. Behav.* **2009**, *12*, 225–234. [CrossRef]

83. Lajunen, T.; Parker, D. Are aggressive people aggressive drivers? A study of the relationship between self-reported general aggressiveness, driver anger and aggressive driving. *Accid. Anal. Prev.* **2001**, *33*, 243–255. [CrossRef]

84. Lobbestael, A.; Cousijn, J.; Brugman, S.; Wiers, R.W. Approach and avoidance towards aggressive stimuli and its relation to reactive and proactive aggression. *Psychiatry Res.* **2016**, *240*, 196–201. [CrossRef]

85. Jambon, M.; Colasante, T.; Peplak, J.; Malti, T. Anger, sympathy, and children's reactive and proactive aggression: Testing a differential correlate hypothesis. *J. Abnorm. Child Psychol.* **2019**, *47*, 1013–1024. [CrossRef] [PubMed]

86. Bobadilla, A.; Wampler, M.; Taylor, J. Proactive and reactive aggression are associated with different physiological and personality profiles. *J. Soc. Clin. Psychol.* **2012**, *31*, 458–487. [CrossRef]

87. Babcock, J.C.; Tharp, A.L.; Sharp, C.; Heppner, W.; Stanford, M.S. Similarities and differences in impulsive/premeditated and reactive/proactive bimodal classifications of aggression. *Aggress. Violent Behav.* **2014**, *19*, 251–262. [CrossRef]

88. Puhalla, A.; McCloskey, M.S. The relationship between physiological reactivity to provocation and emotion dysregulation with proactive and reactive aggression. *Biol. Psychol.* **2020**, *155*, 107931. [CrossRef] [PubMed]

89. Ajzen, A.; Fishbein, M. Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychol. Bull.* **1977**, *84*, 888–918. [CrossRef]

90. Irving, H.; Smith, C.T. Measure what you are trying to predict: Applying the correspondence principle to the Implicit Association Test. *J. Exp. Soc. Psychol.* **2020**, *86*, 103898. [CrossRef]

91. Gawronski, A.; Morrison, M.; Phills, C.; Galdi, S. Temporal stability of implicit and explicit measures: A longitudinal analysis. *Pers. Soc. Psychol. Bull.* **2017**, *43*, 300–312. [CrossRef]

92. Steinberg, A. A social neuroscience perspective on adolescent risk-taking. *Dev. Rev.* **2008**, *28*, 78–106. [CrossRef]

93. Lajunen, T.; Summala, H. Can we trust self-reports of driving? Effects of impression management on driver behaviour questionnaire responses. *Transp. Res. Part F Traffic Psychol. Behav.* **2003**, *6*, 97–107. [CrossRef]

94. Oswald, F.L.; Mitchell, G.; Blanton, H.; Jaccard, J.; Tetlock, P.E. Predicting ethnic and racial discrimination: A meta-analysis of IAT criterion studies. *J. Pers. Soc. Psychol.* **2013**, *105*, 171–192. [CrossRef]

95. Rothermund, A.; Wentura, D. Underlying processes in the implicit association test: Dissociating salience from associations. *J. Exp. Psychol. Gen.* **2004**, *133*, 139. [CrossRef]

96. Olson, M.A.; Fazio, R.H. Reducing the influence of extrapersonal associations on the implicit association test: Personalizing the IAT. *J. Personal. Soc. Psychol.* **2004**, *86*, 653. [CrossRef] [PubMed]

97. Van Bockstaele, B.; van der Molen, M.J.; van Nieuwenhuijzen, M.; Salemink, E. Modification of hostile attribution bias reduces self-reported reactive aggressive behavior in adolescents. *J. Exp. Child Psychol.* **2020**, *194*, 104811. [CrossRef]

98. Hazebroek, F.; Howells, K.; Day, A. Cognitive appraisals associated with high trait anger. *Personal. Individ. Differ.* **2001**, *30*, 31–45. [CrossRef]

99. Gagnon, J.; Aubin, M.; Emond, F.C.; Derguy, S.; Brochu, A.F.; Bessette, M.J.P. An ERP study on hostile attribution bias in aggressive and nonaggressive individuals. *Aggress. Behav.* **2017**, *43*, 217–229. [CrossRef] [PubMed]

100. Crago, R.V.; Renoult, L.; Biggart, L.; Nobes, G.; Satmarean, T.; Bowler, J.O. Physical aggression and attentional bias to angry faces: An event related potential study. *Brain Res.* **2019**, *1723*, 146387. [CrossRef] [PubMed]

101. White, B.A.; Turner, K.A. Anger rumination and effortful control: Mediation effects on reactive but not proactive aggression. *Personal. Individ. Differ.* **2014**, *56*, 186–189. [CrossRef]

102. Suhr, A.; Nesbit, S.M. Dwelling on 'Road Rage': The effects of trait rumination on aggressive driving. *Transp. Res. Part F Traffic Psychol. Behav.* **2013**, *21*, 207–218. [CrossRef]

103. Galovski, T.E.; Malta, L.S.; Blanchard, E.B. *Road Rage: Assessment and Treatment of the Angry, Aggressive Driver*; American Psychological Association: Worcester, MA, USA, 2006.

104. Malta, S.; Blanchard, E.B.; Freidenberg, B.M. Psychiatric and behavioral problems in aggressive drivers. *Behav. Res. Ther.* **2005**, *43*, 1467–1484. [CrossRef]

105. Polanczyk, G.; de Lima, M.; Horta, B.; Biederman, J.; Rohde, L. The worldwide prevalence of ADHD: A systematic review and metaregression analysis. *Am. J. Psychiatry* **2007**, *164*, 942–948. [CrossRef] [PubMed]

106. Factor, I.; Rosen, P.J.; Reyes, R.A. The relation of poor emotional awareness and externalizing behavior among children with ADHD. *J. Atten. Disord.* **2016**, *20*, 168–177. [CrossRef]

107. Martel, M.; Nigg, J.T. Child ADHD and personality/temperament traits of reactive and effortful control, resiliency, and emotionality. *J. Child Psychol. Psychiatry* **2006**, *47*, 1175–1183. [CrossRef] [PubMed]

108. Randell, A.; Charlton, S.; Starkey, N. Driving with ADHD: Performance effects and environment demand in traffic. *J. Atten. Disord.* **2016**, *24*, 1570–1580. [CrossRef]

109. Vaa, T. ADHD and relative risk of accidents in road traffic: A meta-analysis. *Accid. Anal. Prev.* **2014**, *62*, 415–425. [CrossRef] [PubMed]

110. American Psychological Association. *Diagnostic and Statistical Manual of Mental Disorders*; American Psychological Association: Washington, DC, USA, 2013.

111. Mazefsky, C.A.; White, S.W. Emotion regulation: Concepts & practice in autism spectrum disorder. *Child Adolesc. Psychiatr. Clin. North Am.* **2014**, *23*. [CrossRef]

112. Ross, V.; Cox, D.J.; Reeve, R.; Brown, T.; Moncrief, M.; Schmitt, R.; Gaffney, G. Measuring the attitudes of novice drivers with autism spectrum disorder as an indication of apprehensive driving: Going beyond basic abilities. *Autism* **2018**, *22*, 62–69. [CrossRef] [PubMed]

113. Mazefsky, C.A.; Kao, J.; Oswald, D.P. Preliminary evidence suggesting caution in the use of psychiatric self-report measures with adolescents with high-functioning autism spectrum disorders. *Res. Autism Spectr. Disord.* **2011**, *5*, 164–174. [CrossRef]

114. Deffenbacher, J.L. A review of interventions for the reduction of driving anger. *Transp. Res. Part F Traffic Psychol. Behav.* **2016**, *42*, 411–421. [CrossRef]

115. Schmidt, N.B.; Vereenooghe, L. Inclusiveness of cognitive bias modification research toward children and young people with neurodevelopmental disorders: A systematic review. *Int. J. Dev. Disabil.* **2020**, 1–16. [CrossRef]