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Typology of aggressive and transgressive drivers

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27 1. Introduction

28 Nowadays road users perceive aggressive driving as one of the most significant problems
29 encountered on the road (AAA Foundation for Traffic Safety, 1997; National Highway
30 Traffic Safety Administration [NHTSA], 1998; Shinar and Compton, 2004). Aggressive
31 driving is a major cause of traffic crashes and injuries (NHTSA, 2000). Indeed, a cross-
32 cultural study of four different countries showed that aggressive driving behavior was
33 significantly correlated with a higher number of crashes (Ozkan et al., 2011).

34 According to the AAA Foundation for Traffic Safety (2009), aggressive driving has been
35 defined as “Any unsafe driving behavior, performed deliberately and with ill-intention or
36 disregard for safety.” Many studies have investigated the relationship between situational
37 variables (Hennessy & Wiesenthal, 1999; Ellison-Potter, Bell, & Deffenbacher, 2001), socio-
38 cultural variables (Marsh & Collett, 1986, 1987), personal variables (Lajunen & Parker, 2001;
39 Britt & Garrity, 2006; Zhang et al., 2017), and aggressive driving. Concerning personal
40 variables, many studies have investigated the relationship between personality (Lajunen &
41 Parker, 2001; Beck, Wang, & Mitchell, 2006; Britt & Garrity, 2006; Dahlen et al., 2012),
42 anger (Deffenbacher, Lynch, Filetti, Dahlen, & Oetting, 2003a; Dahlen, Martin, Ragan, &
43 Kuhlman, 2005; Berdoulat et al., 2013) and aggressive and transgressive driving. Moreover,
44 few studies have examined the link between motivational variables (investigating by the self-
45 determination model) and aggressive driving (Knee, Neighbors, & Vietor, 2001). Among
46 these studies, some have emphasized the central role of motivation in aggressive and
47 transgressive driving (Jovanovic, Stanojevic, & Stanojevic, 2011; Lennon & Watson, 2011)
48 and the possibility to differentiate aggressive driver profiles. However, with the authors
49 relying on different theoretical models, it seems difficult to conceptualize these motivations in
50 a systematic way. Moreover, few studies have investigated the combination of multiple

51 psychological processes in the explanation of both aggressive and transgressive driving
52 (Dahlen et al., 2005).

53 Even though most of the studies have examined the separate effects of various psychological
54 variables, their articulation within aggressive driver profiles is little studied.

55 Regarding driver profiles, a number of studies have emphasized the importance of identifying
56 which types of driving behaviors are problematic, and which sub-groups engage in these
57 behaviors (Martinussen et al., 2014 ; Martinussen et al., 2017 ; Møller et al., 2015). In their
58 study, Møller et al. (2015) focused on 3 types of drivers: Non-drunk drivers, Drunk driving
59 non-recidivists, and Drunk driving recidivists, with respect to their demographic and socio-
60 economic characteristics, road accident involvement and other traffic and non-traffic-related
61 law violations. The results showed that the recidivist group is more involved than the other
62 groups in road crashes and transgressive behavior in driving and other motives. Another study
63 (Martinussen et al. 2014) highlighted the existence of four profiles of drivers, based on self-
64 report measures assessed by DBQ and DSI. These subgroups differ in their propensity to have
65 aberrant driving behaviors. The two profiles Violating unsafe drivers and Unskilled unsafe
66 drivers reported higher frequency of driving aberrations and lower skill level than the two
67 profiles Skilled safe drivers and Low confidence safe drivers. These groups are also
68 differentiated by age, gender, number of crashes and average number of kilometers per year.
69 These typologies propose to distinguish drivers according to a specific behavior, such as
70 drinking alcohol, or according to their driving skills and transgression. However, none of
71 them focus on the aggressive driving issue. Regarding this point, Novaco (1991) developed a
72 typology of roadway aggression forms, differentiating six different types: (1) roadway
73 shootings/throwings, (2) assault with the vehicle, (3) sniper/robber attacks, (4) drive-by
74 shootings, (5) suicide/murder crashes, and (6) roadside confrontations. These various forms
75 were also arrayed in that typology with regard to six contextual factors, which were target

76 location, aggressor location, target identity, temporal interval, intentional quality, and traffic
77 relevance. Elsewhere, Vallières et al. (2008) have developed a quantitative typology of
78 aggressive drivers based on three variables: perception of intentionality, reactive anger, and
79 aggressive driving. This study has shown that driver profiles are part of a continuum from the
80 most aggressive to the least aggressive. Nevertheless, these typologies, based on roadway
81 aggression and personal variables, require detailed investigation. Indeed, for the development
82 of effective preventive and rehabilitative measures it is crucial to know which types of
83 personal variables and even psychopathological profiles are problematic in the context of road
84 safety.

85 Consequently, it seems of prime importance to provide an in-depth examination of these
86 issues. The aim of the present study was to establish a typology of aggressive drivers based on
87 psychological variables (anger, motivation). Specifically, the main objective of the current
88 study was to examine the combination of these psychological variables within aggressive
89 driver profiles.

90

91 Anger, considered as a complex human emotion, is a psychological variable that has received
92 attention for its role in both dangerous and aggressive driving. To clarify the concept of anger
93 as a psychological construct, Spielberger and colleagues (e.g., Spielberger, 1999; Spielberger,
94 Jacobs, Russell, & Crane, 1983; Spielberger et al., 1995) have adapted the theory of state-trait
95 personality to anger.

96 State anger is an emotional and physiological condition that occurs in response to an
97 immediate situation. It might be of varying intensity and fluctuates over short periods. Arnett
98 et al. (1997) showed that anger was the only mood state that predicted reckless driving. These
99 results suggest that an individual's anger state could prove to be an important predictor of
100 angry behaviors while driving.

101 Regarding trait anger, this construct corresponds to a stable personality dimension leading to
102 feelings of anger. When confronted with specific social situations or stimuli, subjects
103 characterized by trait anger are more likely to experience states of anger (Deffenbacher,
104 Oetting, Thwaites, Lynch, Baker, Stark, Thacker et al., 1996). Trait anger played an important
105 role in driving behavior (Ge et al., 2017). Indeed, studies have shown positive correlations
106 between trait anger and dangerous driving behavior and crashes. Trait anger was correlated
107 with aggressive anger expressions such as verbal, physical, and even vehicular response
108 (Deffenbacher, Lynch, Deffenbacher, & Oetting, 2001; Deffenbacher, Lynch, Oetting, &
109 Swaim, 2002). Many researchers have focused on this operational and theoretical distinction
110 between state anger and trait anger that has been replicated to driving anger. According to
111 these authors, anger might be a temporary feeling developed after a particular traffic situation
112 (state) or may be a stable personality dimension.

113 However, Deffenbacher et al. (1996) have emphasized that trait anger might be characterized
114 by a greater intensity and frequency in its expression, leading to an inadequate expression of
115 this anger. Concerning this point, DiGiuseppe and Tafrate (2006) have made the assumption
116 of the existence of anger disorder as a primary psychopathological disorder. Indeed,
117 DiGiuseppe and Tafrate (2006) underlined that anger has not been recognized as a distinctive
118 emotional disturbance suitable for inclusion in the DSM-IV-TR. However, several diagnoses
119 include anger as a possible symptom in their criteria (such as Oppositional Defiant Disorder).
120 The diagnostic category most used by professionals to diagnose patients with excessive anger
121 is Intermittent Explosive Disorder. Anger is perceived as a problem with impulse control.
122 However, DiGiuseppe and Tafrate (2006) emphasize the fact that this disorder does not seem
123 to appropriately describe the characteristics of some patients who have difficulty with their
124 anger. These authors emphasize that anger disorder might exist in the absence of other
125 psychopathological disorders or appears in addition to other disorders. To treat and assess

126 clinically this disorder, DiGiuseppe and Tafrate (2004) created a scale: the Anger Disorders
127 Scale (ADS). This scale is based on three specific criteria to assess anger disorder: duration,
128 intensity, and chronicity. The duration refers to the period during which the person admits
129 suffering from an anger problem. In general, the DSM-IV-TR indicates that a period of at
130 least 6 months during which the subject experiences a disorder meets the criteria for an Axis I
131 disorder. The intensity of the emotional response is an indicator used in psychopathology. On
132 this indicator, the number of stimuli or triggers causing emotional response seem to be the
133 most important elements to consider. Finally, the chronicity or the frequency of an episode of
134 anger is also an indicator of an anger disorder. A serious episode once a week or more
135 represents a sufficiently high frequency to consider the presence of anger disorder. According
136 to these findings, we could ask ourselves if aggressive and transgressive drivers, who are
137 more likely to present a psychological or emotional vulnerability (Fong et al., 2001; Galovsky
138 et al., 2002; Malta et al., 2005), would be more likely to develop anger disorder. Moreover,
139 Nesbit et al. (2007) indicate that anger is generally associated with aggressive driving;
140 however, subtypes of anger do not differentially predict negative driving outcomes.
141 Nevertheless, to our knowledge, no study has investigated the association between a possible
142 anger disorder, state-trait anger and both aggressive and transgressive driving behaviors.

143

144 Another important and multifaceted psychological construct that has been defined in multiple
145 ways by different authors is motivation. This psychological variable has received attention for
146 its role in both aggressive and transgressive behaviors. However, to our knowledge, only four
147 studies investigated the role of motivation in dangerous driving (Knee et al., 2001; Neighbors
148 et al., 2002; Jovanovic et al., 2011; Lennon & Watson, 2011). Knee et al. (2001) and
149 Neighbors et al. (2002) described a motivational model of aggressive driving based on the
150 self-determination model (Deci & Ryan, 1985, 1987). According to this model, motivation is

151 defined as a stable psychological disposition. This model suggests the existence of several
152 types of motivation—including autonomous motivation and controlled motivation.
153 Autonomous motivation implies that the individual behaves with a full feeling of free choice,
154 while controlled motivation supposes that the person acts rather under the influence of
155 pressures and demands linked to a specific performance and perceived as being external to it.
156 According to these studies (Knee et al., 2001; Neighbors et al., 2002), it would appear that
157 individuals with controlled motivation are more aggressive on the road than individuals with
158 autonomous motivation. It also appears that driving anger is a mediator between motivation
159 (especially controlled) and aggressive driving.

160 Other authors (Jovanovic et al., 2011) have pointed out the strong impact of motivations on
161 aggressive driving. Indeed, aggressive driving behaviors can be subtended by different
162 motives (Lennon & Watson, 2011). However, these studies have limits: qualitative methods
163 (interview, journal) that do not allow a generalization of the results, and a tool for assessing
164 motivation without theoretical framework (Jovanovic et al., 2011; Lennon & Watson, 2011).
165 Consequently, it seems of prime importance to provide an in-depth examination of these
166 issues with a theoretical reference framework: Apter's reversal theory (2001).

167 Reversal theory (Apter, 2001) is a general psychological theory of personality, motivation,
168 and emotion. This theory has proved useful for elucidating a wide variety of phenomena
169 encompassing a great diversity of motives, such as addiction (Cardenal et al., 2007),
170 consulting a complementary and alternative medical practitioner (Cottencin et al., 2006),
171 violence (Kerr, 2009), and dangerous sport (Kerr & Males, 2011). This theory suggests that
172 individuals' behavior is strongly influenced by the configuration of current metamotivational
173 states. These states exist and function in opposing ways. Each pair of states is mutually
174 exclusive, that is, individuals can only experience one of the two opposing states at a given
175 time. These pairs of states are thought to exist together as alternative stable states within

176 bistable systems, and individuals are thought to alternate or reverse between them. There are
177 four pairs of states that reflect basic human psychological motives, or needs and experience.
178 The pairs of states have been labeled “telic-paratelic” (achievement and serious vs. fun and
179 playful), “conformist-negativistic” (following natural laws, social codes, rules; showing
180 respect or obedience vs. freedom and challenge), “autic-alloic” (individuation- and self-
181 oriented vs. identifying with and focusing on the needs and interests of others), and “mastery-
182 sympathy” (trying to dominate people, things, or situations vs. love and affection) (Apter,
183 2001).

184

185 1.1. Aim and Objective

186 The aim of this study was to establish a typology of aggressive drivers. The originality of this
187 research is based on two points: (1) examining the pattern in which aggressive driving
188 motives and aggressive driving were ordered in different clusters of drivers and (2)
189 investigating if anger disorders, state-trait anger, and transgressive driving motives could
190 differentiate between the different profiles of drivers. Indeed, for the development of effective
191 preventive and rehabilitative measures it is crucial to know which types of personal variables
192 and even psychopathological profiles are problematic in the context of road safety. Moreover,
193 Reversal theory offers a promising perspective for psychological care, since it is allowing
194 changes in problematic behavior by reversing metamotivational states.

195

196 2. Methodology

197 2.1. Participants

198 The participants were unpaid volunteers, some of whom were recruited on different Internet
199 forums (automobile forum, tuning forum, fireman forum, nurse forum, etc.) and in public

200 places (university, public libraries, the main train station, shopping centers, etc.). Three
201 inclusion criteria were considered: (1) participants had to be 18 years old or over, (2) to have
202 had driver's license (Category B), and (3) to drive regularly for at least one year (at least one
203 day per week). A total of 383 participants agreed to take part in the study and completed the
204 questionnaire, either the paper version or electronic version. The paper version of the
205 questionnaire was completed by 53 individuals. The online version was completed by 330
206 participants. Table 1 shows the main characteristics of the sample (age, gender, occupation,
207 and marital status). All participants were French, aged 18–78 years ($M = 35.69$, $S.D. =$
208 13.39); 147 (38.38%) were women, and 236 (61.62%) were men. The majority of participants
209 were employees ($n = 168$, 43.86%) and married ($n = 139$, 36.29%).

210

211 Insert Table 1

212

213 2.2. Instruments

214 2.2.1. Aggressive Driving Behavior Scale (ADBS)

215 The Aggressive Driving Behavior Scale (Houston et al., 2003) lists 11 unsafe driving
216 practices that could be interpreted as aggressive. This scale assesses two types of driving
217 behavior: "Conflict Behavior" and "Speeding." Conflict Behavior involves direct social
218 interaction with other drivers and is characterized by incompatible actions that elicit conflict
219 responses such as rude gesturing. The Speeding scale includes unsafe driving practices that do
220 not necessarily involve other drivers (such as failing to slow for yellow lights). For each
221 ADBS question, respondents were required to rank on a 6-point Likert scale (ranging from
222 1 = *Never* to 6 = *Always*) the frequency with which they have engaged in each of the 11

223 behaviors over the past 6 months. The version used in this study showed to have good
224 reliability and validity ($\alpha = .76$).

225

226 2.2.2. State-Trait Anger Scale (STAS)

227 State-trait anger was measured with the 30-item STAS (Spielberger et al., 1983). This scale
228 assesses state anger (15 items) and trait anger (15 items). The State Anger scale involves the
229 transitory experience of anger, and the Trait Anger scale implicates the individual's stable
230 disposition to feel angry. For each STAS question, participants were required to rank on a 4-
231 point Likert scale (ranging from 1 = *Not at all* to 4 = *Almost always*) the frequency with
232 which they have felt each of the 30 situations. The internal consistency (Cronbach's alpha) of
233 the two subscales was good (State anger: $\alpha = .93$; Trait anger: $\alpha = .86$).

234 2.2.3. Anger Disorders Scale Short (ADS:S)

235 The ADS (DiGiuseppe & Tafrate, 2004) specifically assesses anger as an independent
236 problem rather than a secondary feature of other disorders. This scale is based on three
237 specific criteria to assess anger disorder: duration, intensity, and chronicity. The
238 multidimensional structure of the ADS represents 18 subscales distributed across five
239 domains of emotions: provocations, arousal, cognitive, motives, and behaviors. In this study,
240 the authors have chosen to use the short form of ADS. The 18-item ADS: Short (ADS:S)
241 contains items from each of the 18 ADS subscales. This scale assesses three factors: Anger-
242 In, Vengeance and Reactivity/Expression. A total score can be calculated. Each response was
243 scored from 1 to 5 using a scale that assesses the duration, intensity, or chronicity of
244 symptoms. Different proposals were presented according to the questions, such as: 1 = *Never*
245 *or rarely*, 2 = *Once a month*, 3 = *Once a week*, 4 = *Several days a week*, 5 = *Almost every day*.
246 The internal consistency was good (Cronbach's $\alpha = .86$).

247 2.2.3. Inventory of Motives of Driving Aggression, Transgression, and Respect for Traffic
248 Rules

249 This questionnaire was composed specifically for the present study. It consisted of 62
250 sentences referring to possible motives of driving aggression, transgression, and respect for
251 traffic rules. The sentences were chosen to include motives derived from all eight
252 motivational states defined in Apter's reversal theory. The common wording of all items—
253 “One of the reasons for which I adopt an aggressive behavior on the road...”—was chosen to
254 reflect the fact that there could be an influence of several motives at the same time or at
255 different times for the same person. The two extremes of the visual analogue response scales
256 were labeled “Completely Disagree” and “Completely Agree” (17-point Likert scale).

257

258 The chosen items were extracted from a large group of sentences expressed by drivers during
259 focus groups (n = 92). This scale assesses eight factors: Transgression as sensation-seeking
260 and mastery (Autic-Paratelic-Mastery; $\alpha = .91$), Respect for the rules/Non-aggression as a
261 protective and altruistic element (Sympathy, Telic, Conformist; $\alpha = .81$), Reactive verbal
262 aggression (Telic, Negativistic; $\alpha = .85$), Aggression to impose oneself on the other (Autic-
263 Mastery, $\alpha = .77$), Transgression as opposition (Mastery, Negativistic, $\alpha = .76$), Respect for
264 the rules as obligation (Negativistic, Autic, $\alpha = .68$), Instrumental transgression (Telic,
265 Mastery, $\alpha = .70$), Aggression as altruistic protection (Alloic, Sympathy, $\alpha = .45$). This
266 structure was obtained following an exploratory factor analysis. Based on the eigenvalue
267 curve extraction rule, eight interpretable factors were identified¹. This 8-factor solution was
268 subjected to a VARIMAX rotation. The 8-factor solution found explains 47.52% of the total
269 variance. A confirmatory factor analysis was conducted on another sample. All coefficients

¹ The scale validation study was conducted on a sample of 707 participants (women: n=234, 33.10%; men: n=473, 66.90%).

270 and indices of fit were satisfactory (GFI = 0.92; CFI = 0.92; RMR = 0.05; RMSEA = 0.04
271 [0.03; 0.05]; $\chi^2(224) = 367.634$; $\chi^2/ddf = 1.64$; $p < 0.001$).

272

273 2.3. Procedure

274 In the case of the online version, participants first provided an electronic signature on the
275 consent form and were then transferred to an online version of the questionnaire. In the case
276 of the paper version, the questionnaires were distributed in public places after informed
277 consent had been obtained. Each questionnaire was distributed with a stamped return
278 envelope. In every case, the consent form explained to participants that they were being asked
279 to take part in a research project investigating driving behaviors. The form assured
280 participants that their responses would remain anonymous. The participants were informed
281 that it took approximately 35 minutes to fill out the questionnaire. The experimenter was not
282 present when the participants filled out the questionnaires, in order to not influence them.

283 Participants completed all measures simultaneously. However, the scores were included to the
284 statistical analyses as follows: since the aim was to create an aggressive driver typology and
285 to distinguish these groups later using complementary variables, data resulting from the scales
286 which were specifically assessing aggressive driving behavior were used as a basis for
287 creating profiles (ADBS and its subscales, as well as the three aggressive driving motives:
288 Aggression to impose oneself on the other ; Aggression as altruistic protection ; and Reactive
289 verbal aggression). The data from other scales (ADS : S ; STAS ; transgression and
290 compliance motives) were used to compare the clusters obtained using ANOVAs.

291

292

293

294 3. Statistical Analysis

295 Cluster analysis was used to identify homogeneous groupings of participants based on
296 aggressive driving (ADBS) and motives for aggressive driving (Reactive verbal aggression,
297 Aggression as altruistic protection, Aggression to impose oneself of the other).

298

299 Cluster analysis was conducted in two steps to generate aggressive driver profiles based on
300 variable scores converted to z-scores. In the first step, a hierarchical cluster analysis was
301 conducted. The dendrogram and the agglomeration schedule were used to identify the number
302 of clusters. In the second step, k-means clustering was used to assign individuals to one of the
303 identified clusters.

304

305 Once cluster group membership had been established for each participant, the groups were
306 then compared by their mean scores on STAS, ADS:S subscales, motives for transgression
307 and respect for traffic rules through a series of one-way ANOVA with the previous variables
308 as dependent variables and cluster groupings as independent variables.

309

310 Discriminant analysis was used to verify the proportion of subjects correctly classified into
311 the classes.

312

313 Pearson's chi square was used to verify the independence assumption of the following
314 categorical variables: Gender and clusters, Age categories and clusters, Marital status and
315 clusters, Occupation and clusters.

316

317 4. Results

318 4.1. Cluster analysis

319 A four-cluster solution was identified. A discriminant analysis showed clear discriminations
320 among the four clusters, Wilks' $k = 0.06$, with 94.51% of the original grouped cases correctly
321 classified. The first group ($n = 116$, 30.29% of the study sample), characterized by a low level
322 of aggressive driving and motives for aggressive driving, was named Respectful. The second
323 group ($n = 35$, 9.14% of the study sample), characterized by a high level of aggressive driving
324 and its subscales Conflict Behavior and high scores for the factors "Aggression to impose
325 oneself on the other" and "Reactive verbal aggression," was named Aggressive-Dominant.
326 The third group ($n = 150$, 39.16% of the study sample), characterized by high scores for the
327 factors "Aggression as altruistic protection" and "Reactive verbal aggression," was named
328 Aggressive-Avenger. Finally, the last group ($n = 82$, 21.41% of the sample), characterized by
329 high level of aggressive driving and its subscales Conflict Behavior and Speeding, was named
330 Aggressive-Situational (Figure 1) (Table 2).

331

332 Insert Figure 1

333 Insert Table 2

334 4.2. ANOVAs

335 The four clusters were clearly distinct on ADS:S and its subscales, STAS and motives for
336 transgression and respect for traffic rules ($F(30, 1086.7) = 6.62; p < 0.001$). Table 3 presents
337 mean scores for all clusters and results of Scheffe's post hoc test. Regarding age, there was a
338 significant difference between the Respectful ($M=37.12$; $SD=13.70$) and the Aggressive-
339 Dominant ($M=29.57$; $SD=10.05$). Aggressive-dominant was characterized by a high level of
340 anger disorder and its subscale Vengeance, state-trait anger and motives for transgression for
341 traffic rules. Aggressive-avenger was characterized by a high level of Anger-In. Aggressive-
342 situational was characterized by a high mean score of "Transgression as sensation-seeking
343 and mastery" and low mean score of "Respect for the rules/Non-aggression as a protective

344 and altruistic element.” Finally, respectful was characterized by a low level of all motives for
345 transgression and high level of motives for respect for traffic rules (Respect for the rules/Non-
346 aggression as a protective and altruistic element).

347

348 Insert Table 3

349 4.3. Pearson’s chi square

350 Since the variables are categorical, the analysis will be based on frequencies, occurrences and
351 proportions in each cell of the cross-tabulation. The significance of the test was measured
352 using Cramer’s Phi and V association indices. These measures range between 0 and 1. The
353 closer the value is to 1, the stronger the relationship.

354 Table 4 indicates the absence of a significant relationship between the four categorical
355 variables Gender, Age categories, Marital Status, Occupation, and the Cluster variable.
356 Indeed, the Pearson’s chi square tests and Cramer’s Phi and V are not significant (Table 4).

357 In a descriptive manner, Table 4 indicates the most important man/women difference for the
358 Aggressive-Dominant (men : 80% ; women : 20%) and Aggressive-Situational (men : 70.7% ;
359 women : 29.3%) profiles. Regarding Age categories, the Aggressive-Avenger profile is the
360 most represented for all ages. We observe the same result for all of the marital statuses.
361 Finally, regarding the Occupation variable, the Aggressive-Avenger profile is the most
362 represented for Business manager (57.1%), Employees (38.7%), Civil servant (48%),
363 Engineers (41.7%) and Retired (55.2%). The Respectful profile is the most represented
364 among Professionals (36.8%), Students (34.7%), and Unemployed (33.3%).

365 Insert Table 4

366

367

368

369 5. Discussion

370 The aim of this study was to establish a typology of aggressive drivers. The originality of this
371 research is based on two points: (1) examining the pattern in which aggressive driving
372 motives and aggressive driving were ordered in different clusters of drivers and (2)
373 investigating if anger disorders, state-trait anger and transgressive driving motives could
374 differentiate between the different profiles of drivers. Four profiles were highlighted:
375 Respectful, Aggressive-Avenger, Aggressive-Situational, and Aggressive-Dominant. The
376 results of this study were consistent with the hypothesis formulated by Vallières et al. (2008)
377 that different categories of aggressive drivers exist. A 4 cluster solution was also suggested by
378 Martinussen et al. (2014), by identifying 2 clusters of risky drivers and 2 clusters of safety-
379 oriented drivers. The first cluster, labeled Respectful, was characterized by a low level of all
380 motives for transgression, low level of aggressive driving and high level of motives for
381 respect for traffic rules (Respect for the rules/Non-aggression as a protective and altruistic
382 element). These drivers, who respect traffic rules, show empathy toward other road users.
383 They do not seem to have any anger predispositions (state-trait anger or anger disorder). This
384 was also the class with the highest average age, which is consistent with previous studies
385 stating that age is negatively correlated with aggressive driving (Abele et al., 2020; Dahlen
386 and White, 2006; Møller and Haustein, 2017; Perepjolkina and Reñge, 2013). This profile can
387 also be compared to the “Skilled safe drivers” profile (Martinussen et al., 2014),
388 corresponding to drivers who are compliant with driving and safety rules.

389

390 The second cluster, named Aggressive-Avenger, was characterized by a high level of Anger-
391 In and high scores for the factors “Aggression as altruistic protection” and “Reactive verbal
392 aggression.” These two motives of road aggression are structured around telic/negativist
393 metamotivational states. A parallel can be drawn between this result and the anger violence

394 concept identified by Apter (1997) and picked up again by Kerr (2009). This type of violence
395 is serious and often retributive in nature, involving anger and unpleasant high arousal. It is
396 associated with a sudden reversal from the conformist to the negativistic state, in combination
397 with the telic state. On the road, it often occurs as an immediate response to interpersonal
398 interactions between drivers that are perceived as incorrect or unfair by the other drivers.
399 Moreover, the high tendency of Anger-In, which is an elevated rumination tendency, may
400 amplify this anger violence phenomenon. Indeed, according to Suhr and Dula (2017),
401 rumination when coupled with negative emotions (such as anger) is a predictor for dangerous
402 and aggressive driving.

403

404 The third cluster, named Aggressive-Situational, was characterized by a high level of
405 aggressive driving and its subscales and high mean score of “Transgression as sensation-
406 seeking and mastery.” The Aggressive-Situational individual displays driving aggression
407 underpinned by emotional motives, in response to the hostile gestures of other drivers. This
408 element is closely linked to their low frustration tolerance. This frustration depends on the
409 way injustice is perceived, and therefore implies moral judgement. For this driver, automobile
410 driving is invested in as a site of emotional release. The identified aggression and driving
411 transgression motives are structured around the paratelic state, corresponding to sensation-
412 seeking, combined with negativist and telic states. This expression was identified by Bowers
413 (1985, 1988) in offending subjects. Drivers from this category use driving as a way to seek
414 thrills by mastering situations and their vehicles. They are transgressive drivers. This profile
415 shows similar characteristics with the “Violating unsafe drivers” profile (Martinussen et al.,
416 2014), which may predispose them to traffic offense. Indeed, the majority of the Aggressive-
417 situational profile category are men (70.3%) and people without partners (Single=31.7% ;

418 Divorced=28%). These characteristics were identified as precursors to risky driving in the
419 study by Martinussen et al. (2017).

420 Finally, the last cluster, labeled Aggressive-Dominant, was characterized by a high level of
421 aggressive driving and its subscales Conflict Behavior and high scores for the factors
422 “Aggression to impose oneself on the other” and “Reactive verbal aggression.” This was also
423 the class with the lowest average age, which is consistent with studies by Abele et al. (2020)
424 and Møller and Haustein (2017) stating that age is negatively correlated with aggressive
425 driving. This profile includes a majority of men (80%). This result is consistent with previous
426 studies indicating that men are more likely than women to commit driving transgressions and
427 to engage in aggressive behaviors while driving (Berdoulat et al., 2013).

428 Moreover, this class was characterized by a high level of anger disorder and its subscale
429 Vengeance, State-trait anger and motives for transgression for traffic rules (Instrumental
430 transgression). This class was characterized by an elevated propensity to present anger issues
431 affecting all areas of their lives. The same tendency applies for state-trait anger. Aggression
432 and transgression, as fundamentals for this category, would appear to be ways to master
433 others or the situation, to have the upper hand. Aggression goes beyond automobile driving
434 and extends to other areas of life. Transgression motives are structured around telic state and
435 mastering. This expression refers to the power violence concept described by Apter (1997)
436 and picked up again by Kerr (2009). Because the telic and mastery states are involved in
437 power violence, it has a profound purpose and tends to take the form of cold, calculated
438 violence.

439

440 6. Limitations

441 A number of limitations should be mentioned. First, the data collection was based on self-
442 report measures. This method is known to have two main limitations: social desirability and

443 cognitive distortions. We can imagine that participants provided socially desirable responses,
444 trying to embellish their real driving behaviors. Yet, the participants were volunteers, and they
445 were assured anonymity and confidentiality: We believe that respondents in our study would
446 not benefit from lying. Moreover, cognitive distortions might have biased the data. For
447 example, minimization is a process that can be found in transgressive drivers who treat fast
448 driving like a game and do not believe that it is a dangerous behavior that may lead to tragic
449 consequences. Second, a part of the data collection was based on the Internet forum. Indeed,
450 the questionnaire was posted on various types of forums. Some of the forums were
451 specialized in the automotive field. However, we could not control the source of participants
452 according to the forums in the data collection (for example, we can imagine that forum
453 visitors can be heterogeneous, oscillating from car fanatics to simple car users). Another
454 limitation is the use of a motivation inventory specifically created for this study. Although
455 this measure shows satisfying psychometric qualities, it would be necessary to replicate this
456 study on other populations in order to confirm these psychometric qualities.

457 Finally, the study presents a sampling bias regarding socio-demographic variables. Indeed, the
458 sampling was not performed equally between the different variables, which may explain the
459 absence of significant results. This point should be corrected in future studies. Plus, it would
460 be relevant to complete it with other information such as the annual number of kilometers, or
461 the number of crashes.

462

463 7. Conclusion

464 The results from this study confirm the existence of different driver clusters based on the
465 following variables: aggressive driving, anger disorder, state-trait anger, and aggressive and
466 transgressive driving motives. Four classes of drivers are identified: respectful, aggressive-
467 avenger, aggressive-situational, and aggressive-dominant. This study provides a contribution

468 at the theoretical and practical levels. Indeed, this research brings forth new empirical
469 findings to the field of aggressive and transgressive driving with the emergence of a typology
470 of aggressive drivers. Moreover, our findings strongly support the importance of creating
471 programs adapted to each driver's profile.

472 These training programs could rely on methods proposed by Deffenbacher et al. (2002) and
473 Strom et al. (2013) for drivers showing elevated anger tendencies on the road as well as
474 aggressive and transgressive driving behaviors. These methods, which focus on Cognitive
475 Behavioral Therapy (CBT), use therapeutic techniques such as breathing and relaxation skills
476 development, cognitive restructuring, or learning new, functional coping strategies.

477 These techniques showed their efficacy; nonetheless, this efficacy depends on the individual's
478 recognition of the problem. Indeed, some individuals do not necessarily comprehend the scale
479 of the problem despite the dramatic consequences they experienced following aggressive
480 behaviors on the road. The authors argue that driver acceptance of their own responsibility
481 and recognition of a certain control of their behavior are key elements to change as regards
482 driving. Our study showed evidence for the central role of motivation in aggressive and
483 transgressive (acting-out) behavior on the road. Moreover, all aggressive drivers do not
484 present the same profile, which leads us to different adapted care from individual to
485 individual. These training programs could focus specifically on the psychotherapeutic
486 treatment of ruminations, especially for Aggressive-avengers. For Aggressive-Situational, the
487 care would be more focused on the management of risk, especially regarding sensation-
488 seeking on the road.

489 Having considered motivations in the context of reversal theory, we can consider clues for
490 treatment in reference to this theory. Indeed, during therapeutic sessions, psychologists could
491 shift some subjects from one motivational state to another (Apter, 2001). To summarize, the
492 techniques described before and learning new adaptation techniques, such as creating a quiet

493 spot in the car, could contribute to creating a space favorable to shifts (for instance, shifting
494 from a telic state, engendering anxiety and stress, to a paratelic state, allowing a feeling of
495 pleasing excitation during driving time).

496 On the other hand, the treatment of anger disorders seems vital, principally regarding
497 aggressive-dominant who often present a severe disorder affecting all areas of their lives.
498 These therapies should be based on an understanding of how these cognitive processes that
499 generate and maintain anger are learned. This is about orienting care on an individual
500 modality, not group (modality used by previously mentioned programs). In this context, these
501 interventions should focus on learning new problem-solving strategies, leading subjects to
502 become aware of the long-term negative consequences of their anger and identify new
503 response modes (DiGiuseppe, Canella, & Kelter, 2007). Relaxation techniques are also
504 recommended. Regarding treatment specific to anger issues, McCloskey, Noblett,
505 Deffenbacher, and Gollan (2008) showed that CBT aimed at learning relaxation techniques,
506 cognitive restructuring sessions, and coping strategies training, followed for 12 weeks,
507 contributed to reducing aggression, anger, hostile thoughts, and depressive symptoms.

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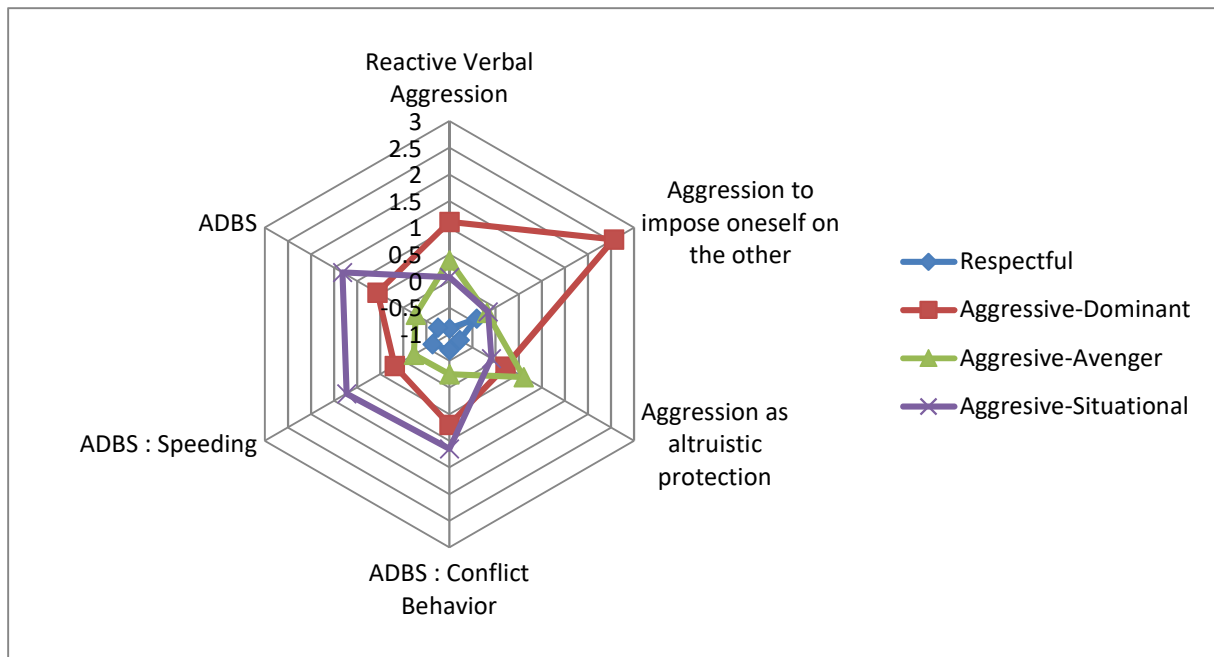


Fig 1. Cluster solution based on aggressive driving and its subscales, and motives for aggressive driving (Reactive Verbal Aggression, Aggression to impose oneself on the other, Aggression as altruistic protection)

Table 1. Characteristics of the sample (n = 383)

Variables	n	%	M	SD
AGE			35,69	13,39
GENDER				
Male	236	61,62		
Female	147	38,38		
OCCUPATION				
Employees	168	43,86		
Students	75	19,58		
Engineers	48	12,53		
Retired	29	7,57		
Civil servants	25	6,53		
Professionals	19	4,96		
Unemployed	12	3,13		
Business manager	7	1,84		
MARITAL STATUS				
Married	139	36,29		
In partnership	129	33,68		
Single	93	24,28		
Divorced	22	5,75		

Table 2. Mean scores for each cluster (Scales used to define clusters)

CLUSTERS	Cluster 1		Cluster 2		Cluster 3		Cluster 4		F	η^2
	<i>Respectful</i>		<i>Aggressive-Dominant</i>		<i>Aggressive-Avenger</i>		<i>Aggressive-Situational</i>			
	n=116		n=35		n=150		n=82			
VARIABLES	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
ADBS	17,06 ^{abc}	3,19	24,63 ^{ade}	5,44	19,80 ^{bdf}	3,05	29,00 ^{cef}	4,19	194,22**	0,61
Conflict Behavior	11,11 ^{abc}	2,41	16,63 ^{ade}	3,86	12,86 ^{bdf}	2,38	18,38 ^{cef}	3,42	126,46**	0,50
Speeding	5,95 ^{abc}	1,51	8,00 ^{ade}	2,47	6,94 ^{bdf}	1,77	10,62 ^{cef}	2,06	111,46**	0,47
Inventory of Motives										
Aggression as altruistic protection	27,25 ^{abc}	9,92	38,09 ^a	7,64	42,46 ^{bd}	6,63	34,80 ^{cd}	11,51	63,58**	0,33
Aggression to impose oneself on the other	10,70 ^{abc}	6,93	52,34 ^{ade}	13,46	13,79 ^{bd}	7,45	14,17 ^{ce}	7,51	259,75**	0,67
Reactive verbal aggression	59,84 ^{abc}	25,91	135,20 ^{ade}	25,10	108,03 ^{bdf}	27,53	95,93 ^{cef}	36,59	88,62**	0,41

Note : Mean scores displaying the same letter while exposing show significant differences from each other (Scheffé post-hoc) * $p < 0,05$; ** $p < 0,001$

Table 3. Mean scores for each cluster (Scales used to describe cluster profiles in more detail)

CLUSTERS	Cluster 1		Cluster 2		Cluster 3		Cluster 4		F	η^2
	<i>Respectful</i>		<i>Aggressive-Dominant</i>		<i>Aggressive-Avenger</i>		<i>Aggressive-Situational</i>			
	n=116		n=35		n=150		n=82			
VARIABLES	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
AGE	37,12 ^a	13,66	29,57 ^a	10,05	36,20	13,97	35,32	12,65	3,01*	0,02
ADS : S	28,84 ^a	6,86	37,74 ^{abc}	9,25	31,11 ^b	6,07	29,72 ^c	6,87	16,04**	0,11
Reactivity/Expression	10,47 ^a	3,46	13,69 ^{abc}	4,54	10,89 ^b	3,30	10,72 ^c	3,72	7,70**	0,06
Anger-In	11,89 ^{ab}	3,31	14,20 ^{ac}	3,63	13,11 ^{bd}	2,63	11,89 ^{cd}	2,96	8,39**	0,06
Vengeance	6,48 ^a	1,89	9,86 ^{abc}	3,77	7,10 ^b	2,29	7,11 ^c	2,01	19,46**	0,13
STAS										
State-Anger	18,85 ^a	4,54	22,89 ^{abc}	9,66	19,79 ^b	5,64	18,84 ^c	3,89	5,43**	0,04
Trait-Anger	23,47 ^{ab}	5,65	31,51 ^{acd}	6,96	25,39 ^{bc}	5,17	24,70 ^d	5,04	19,70**	0,13
Inventory of Motives										
Transgression as opposition	10,78 ^a	8,50	28,17 ^{abc}	24,47	14,64 ^b	12,48	14,95 ^c	12,11	16,12**	0,11
Respect for traffic rules as obligation	62,85	19,06	63,96	14,51	66,85	15,40	61,22	18,94	2,22	0,02
Transgression as sensation seeking and mastery	64,68 ^{abc}	38,46	135,66 ^{ade}	48,76	90,12 ^{bd}	41,77	103,32 ^{ce}	52,37	27,87**	0,18
Instrumental transgression	9,47 ^{ab}	8,93	25,83 ^{acd}	16,47	16,45 ^{bc}	13,68	14,40 ^d	11,52	17,67**	0,12

Respect for the rules / Non-aggression as a protective and altruistic element	129,03 ^{ab}	33,42	108,57 ^{ac}	33,04	130,86 ^{cd}	28,80	108,76 ^{bd}	37,50	11,70 ^{**}	0,08
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Note : Mean scores displaying the same letter while exposing show significant differences from each other (Scheffé post-hoc) * $p < 0,05$; ** $p < 0,001$

Table 4. Cross-Tabulations and Pearson's Chi square for the variables Gender*Clusters ; Age categories*Clusters ; Marital Status*Clusters and Occupation*Clusters

		CLUSTERS					Total
			<i>Respectful</i>	<i>Aggressive-Dominant</i>	<i>Aggressive-Avenger</i>	<i>Aggressive-Situational</i>	
GENDER	Women	Effective	49	7	67	24	147
		% included in "Clusters"	42.2%	20%	44.7%	29.3%	38,4%
	Men	Effective	67	28	83	58	236
		% included in "Clusters"	57.8%	80%	55.3%	70.7%	61.6%
Pearson's chi square =11.16 (ddl=3 ; p=0.01) Cramer's V and Phi=0.17 (p=0.01)							
AGE CATEGORIES	18-24 years	Effective	27	11	38	19	95
		% included in "Clusters"	23.3%	31.4%	25.3%	23.2%	24.8%
	25-44 years	Effective	54	22	70	45	191
		% included in "Clusters"	46.6%	62.9%	46.7%	54.9%	49.9%
	45-64 years	Effective	32	2	36	18	88
		% included in "Clusters"	27.6%	5.7%	24%	22%	23%
	65 and more	Effective	3	0	6	0	9
		% included in "Clusters"	2.6%	0%	4%	0%	2.3%
Pearson's chi square =13.22 (ddl=9 ; p=0.15) Cramer's V =0.10 and Phi=0.18 (p=0.15)							
MARITAL STATUS	Married	Effective	51	6	55	27	139
		% included in "Clusters"	44%	17.1%	36.7%	32.9%	36.3%

Single	Effective	24	10	36	23	93
	% included in “Clusters”	20.7%	28.6%	24%	28%	24.3%
In partnership	Effective	7	0	9	6	22
	% included in “Clusters”	6%	0%	6%	7.3%	5.7%
Divorced	Effective	34	19	50	26	129
	% included in “Clusters”	29.4%	54.3%	33.3%	31.7%	33.7%

Pearson’s chi square =14.61 (ddl=9 ; p=0.10)

Cramer’s V =0.11 and Phi=0.19 (p=0.10)

OCCUPATION	Professionals	Effective	7	2	5	5	19
		% included in “Clusters”	6%	5.7%	3.3%	6.1%	5%
	Business manager	Effective	2	0	4	1	7
		% included in “Clusters”	1.7%	0%	2.7%	1.2%	1.8%
	Employees	Effective	53	17	65	33	168
		% included in “Clusters”	45.7%	48.6%	43.3%	40.2%	43.9%
	Civil servant	Effective	6	1	12	6	25
		% included in “Clusters”	5.2%	2.9%	8%	7.3%	6.5%
	Students	Effective	26	6	26	17	75
		% included in “Clusters”	22.4%	17.1%	17.3%	20.7%	19.6%
	Engineers	Effective	12	5	20	11	48
		% included in “Clusters”	10.3%	14.3%	13.3%	13.4%	12.5%
	Retired	Effective	6	1	16	6	29

	% included in “Clusters”	5.2%	2.9%	10.7%	7.3%	7.6%
Unemployed	Effective	4	3	2	3	12
	% included in “Clusters”	3.4%	8.6%	1.3%	3.7%	3.1%

Pearson’s chi square =15.31 (ddl=21 ; p=0.80)

Cramer’s V =0.11 and Phi=0.20 (p=0.80)

Total	Effective	116	35	150	82
	% included in “Clusters”	100%	100%	100%	100%
