RÉSUMÉ LONG EN FRANÇAIS DE LA THÈSE

PRÉSENTÉE PAR GUILHERME PREVIDI OLANDOSKI A l'UNIVERSITÉ PARIS 8

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COLÈRE AU VOLANT CHEZ LES AUTOMOBILISTES SUR LES ROUTES BRÉSILIENNES ET ÉCO-CONDUITE COMME UNE FAÇON DE RÉDUIRE LA COLÈRE.

I Contexte et cadre théorique

1.1. Les accidents de la route

Les données récentes sur la sécurité routière au niveau mondial (OMS, 2015), font état de 1.25 million de tués sur les routes par an dans le monde en 2013 avec environ 50 millions d'individus survivant avec des blessures dans 178 pays. Les accidents de la route représentent la première cause de mortalité chez les 15-29 ans. Depuis 2007, la survenue de ces sinistres atteint une certaine stabilité due principalement aux actions de sécurité routière adoptées par les organismes nationaux qui ont permis de sauver des vies (OMS, 2015).

Le problème de la mortalité routière est plus grave dans les pays à revenu faible ou à revenu intermédiaire comparés aux pays à revenu plus élevé. L'OMS (2010) estime que 90% des décès surviennent dans les pays à revenu les plus bas, y compris au Brésil. En même temps, ces pays possèdent moins de la moitié des véhicules de la planète (47%), ce qui montre que conduire un véhicule - en particulier une moto - est beaucoup plus risqué dans ces lieux. Examinant le problème, le continent africain est le lieu où les accidents font le plus de victimes. En Afrique, le taux de mortalité est de 26,6 pour 100 000 habitants, contre 9,3 pour 100 000 en Europe et de 15,9 pour 100 000 habitants en Amérique (OMS, 2015).

La plupart des victimes dans le monde sont enregistrées en Libye, avec 73,4 décès par an pour 100 000 habitants, et la Thaïlande avec 36,2 pour 100 000 habitants. Au Brésil, le taux est de 23,4 pour 100 000 habitants, il est similaire au taux du continent africain. L'Europe est la région du monde où la route est plus sûre. Dans les pays où la réglementation est plus stricte, comme le Royaume-Uni, la Suède, les Pays-Bas et la Norvège, le nombre annuel d'accidents de la route est inférieur à 4 pour 100 000 habitants (OMS, 2015). Le Brésil se classe au cinquième rang parmi les pays les plus touchés par les tués dans les accidents de la route. Il est précédé par l'Inde, la Chine, les États-Unis et la Russie, suivi par l'Iran, le

Mexique, l'Indonésie, l'Afrique du Sud et l'Égypte. Ensemble, ces dix pays représentent 62% des tués dans les accidents de la route (Brésil, 2011).

Cette thèse de doctorat se focalise sur le phénoménal risque d'accident au Brésil, le 5ème pays au monde sur le plan du nombre d'accidents de la route (OMS, 2015). Même si le Brésil représente une grande économie du monde qui dispose des ressources nécessaires pour changer ce phénomène, ce problème a augmenté dans le pays (OMS, 2015). L'autre problème est que les stratégies gouvernementales brésiliennes antérieures axées sur la publicité ont échoué (Brasil, 2000).

De plus, le traumatisme infligé aux victimes et à leur famille, les accidents de la route représentent des coûts financiers élevés pour la société (Rozestraten, 2003). Au Brésil, ces accidents de la route sont à l'origine d'une perte de l'ordre de 1,2% du PIB (OMS, 2015). Selon les calculs effectués par IPEA (2015) (Institute of Applied Economics Research) sur les coûts des accidents de la route au Brésil, environ 170 000 accidents de la route survenus sur les routes fédérales brésiliennes en 2014 ont généré un coût sociétal de 3.86 milliards de dollars R$. Parmi eux, 64,7% des coûts sont associés aux victimes de l'accident, tels que les soins de santé et la perte de production due aux blessures ou à la mort, et 34,7% des coûts sont associés aux véhicules, tels que les dommages matériels et les procédures de révocation (IPEA, 2015). Les facteurs humains, tels que l'agressivité, sont la principale cause de 90% des accidents de la route (Rozestraten, 2003). En conséquence, l'objectif de notre étude est d'étudier l'effet de l'agressivité sur la conduite.

1.2 Objectif central de la thèse

Au cours des années, plusieurs études ont évalué les causes des aspects psychologiques des événements routiers, tels que la perception du risque, les attitudes, les croyances et, en particulier, les traits de personnalité (Fernandes, Hatfield et Job, 2010), Hoffmann et González, Braga, Moreira et Botelho, 2003, Montoro, Alonso, Esteban et

Toledo, 2000, Marin et Summala, 1996, Rajalin, 1994). De plus, au cours de la dernière décennie, de nombreuses études internationales ont établi une relation entre les traits de personnalité et le comportement à risque routier, et certains de ces traits se démarquent. Par exemple, l'ensemble des traces appelées colère est prédictive de comportements à risque tels que « dépasser la limite de vitesse » et « infractions », outre l'historique des infractions et des accidents de la route (Düren, 2003; Ulleberg & Rundmo, Martin, Ragan et Kuhlman, 2005, Dahlen et White, 2006, Machin et Sankey, 2008, Fernandes et al., 2010). L'agressivité et l'impulsivité sont également apparues comme de puissants prédicteurs des comportements à risque, en particulier chez les jeunes hommes (Sümer, 2003; Ulleberg et Rundmo, 2003; Machin et Sankey, 2008).

Au Brésil, l'agressivité sur les routes est un problème majeur qui pourrait être un facteur important du taux élevé d'accidents (Cuffa, 2016). Selon Marín-Léon et Vizzotto (2003), les principaux problèmes d'agressivité enregistrés par les automobilistes brésiliens sont liés à la vitesse (20%), aux combats dans la circulation (8%), au feu rouge (15%), à l'alcool au volant et interdit de dépasser (20%). Comme nous l'avons déjà montré, le nombre d'accidents et le coût financier qui en résulte sont un problème pour le gouvernement brésilien avec des résultats beaucoup plus dévastateurs que la guerre (Brasil, 2011). Cependant, le pays s'est efforcé de réduire les accidents et d'éviter l'agressivité des automobilistes au volant par des mesures telles que des campagnes nationales de communication, la modification ou création de lois routières strictes ainsi que l'offre de programmes d'éducation routière à la population.

L'augmentation du nombre d'accidents de route au Brésil montre qu'il est nécessaire de mener des études pour identifier les antécédents des risques routiers afin de pourvoir mettre en œuvre des actions plus efficaces.

Le comportement agressif et la colère ne sont pas toujours liés à la personnalité d'un individu; ils peuvent également se produire en raison de l'état émotionnel du moment ou en réaction à un événement (Silva, 2008). L'agressivité a été citée comme l'un des principaux contributeurs aux accidents de la route. Dans d'autres pays (Villieux et Delhomme, 2010, Sârbescu, 2012, Sullman, Stephens et Yong, 2015), le niveau d'agressivité chez les automobilistes a été mesuré avec succès en utilisant la DAX (Inventaire de l'expression de la colère au volant) (Deffenbacher et al. 2002). Il s'est agi dans ce travail d'adapter la DAX dans le contexte brésilien et d'en examiner les corrélations avec l'échelle de recherche de sensations et l'échelle d'hostilité, comme Delhomme, Chaurand et Paran (2012). Ces échelles permettent de mieux comprendre l'occurrence des comportements d'agressivité chez les conducteurs.

Au total, l'objectif global de la thèse est d'étudier l'agressivité dans la conduite au Brésil et de contribuer avec une approche différente à la question de l'agressivité et à une meilleure compréhension du comportement des automobilistes dans différents contextes. L'accent sera mis sur les facteurs individuels et leurs sources d'influence à la fois du contexte social et environnemental et de leurs interactions qui, en plus des facteurs externes, peuvent affecter le comportement de conduite. L'objectif principal de cette thèse est donc d'étudier le rôle de l'agressivité sur les routes au Brésil et d'examiner comment, en pratiquant l'éco-conduite, il est possible de réduire l'agressivité et d'améliorer la sécurité routière et la mobilité.

1.3. Approche de recherche

Les stratégies d'évaluation utilisées pour étudier l'agressivité au volant selon Dahlen et White (2006) vont des tests psychologiques tels que les techniques projectives et les échelles de personnalité aux techniques psychiatriques ou aux entretiens (Machin et Sankey, 2008). L'utilisation d'échelles devrait être bénéfique en termes de fiabilité et de validité (Storry, 2017). Lorsqu'ils sont correctement utilisés, des instruments normalisés et appropriés peuvent fournir des informations utiles sur les caractéristiques personnelles d'un individu (Cantini, Santos, Machado, Nardi et Silva, 2015).

Les enregistrements d'accidents peuvent produire des résultats équivoques (Fernandes, Hatfield & Job, 2010). Pour Jovanovic, Lipovac, Stanojevic et Stanojevic (2011), lorsqu'ils sont reliés à la personnalité ou à des traits sociaux spécifiques car ils ne sont pas validés en raison de problèmes méthodologiques inhérents au manque de contrôle lié à la variation de l'exposition au danger ou encore au manque de validation des résultats avec différentes populations (Jovanovic et al., 2011). Les résultats dans ce domaine doivent donc être traités avec prudence.

Les tués dans les accidents de la route sont rarement qualifiés de suicides (Brasil, 2011). Mais, les recherches suggèrent que probablement moins de cinq pour cent de tous les tués en voiture sont des suicides (Pelsmacker et Janssens, 2007). De plus, bien que les caractéristiques des suicides et des personnes impliquées dans des accidents mortels soient considérablement plus déviantes que la population générale, la plus grande déviation a été fondée sur l'échantillon de suicidés (Pelsmacker et Janssens, 2007).

La propension aux accidents a été attribuée à des facteurs personnels qui entraînent la survenue d'accidents. Cela a du sens, car, comme l'ont noté Sullman et al. (2015), les rapports d'actes de violence intentionnelle ou de dommages malveillants sur la route avec les conducteurs de la route montrent que ces événements sont rares mais existent toutefois. Pour Jovanovic et al. (2011), le concept de propension aux accidents a un poids important dans les facteurs de personnalité des conducteurs impliqués dans les accidents. Cette propension se réfère à un ou plusieurs traits ou types de personnalité (Cuffa, 2016).

Les conducteurs avec un risque d'accident élevé présentnt une grande variété de caractéristiques communes. Certaines caractéristiques démographiques sont associées à un plus grand risque d'implication dans un accident (Constantinou, Panayiotou, Konstantinou, Loutsiou-Ladd et Kapardis, 2011), telles que les automobilistes ayant moins 25 ans, un niveau de formation faible et une scolarité inférieure à douze ans (Bartholomeu, 2008). Au sein de cette population, les conducteurs à haut risque constituent des sous-groupes tels que les conducteurs conduisant sous l'influence de l'alcool, les jeunes conducteurs et éventuellement les malades mentaux (Bacchieri et Barros, 2011).

Selon Cannell (2001), l'agressivité et les traits de personnalité contribuent énormément au nombre d'accidents. Pour Bachoo, Bhagwanjee et Govender (2013), les facteurs personnels associés aux accidents de véhicules ont généralement des niveaux élevés d'agressivité et d'hostilité, de compétitivité, de peu d'intérêt pour les autres, de libération émotionnelle, d'impulsivité et d'attitudes à assumer. Dans le contexte de perturbation sociale et de détournement, il semble plus courant d'attribuer l'erreur et/ou l'infraction aux conducteurs impliqués dans des accidents (Silva, 2008). La valeur potentielle de la recherche sur la personnalité et les caractéristiques sociales du conducteur à risque contribue à construire des moyens efficaces pour prédire avec fiabilité un accident (Bachoo et al., 2013; Sullman et al., 2015). Cependant, si ces caractéristiques présentent une certaine cohérence, il ne semble pas y avoir un seul test ou une seule batterie de tests permettant de prédire la responsabilité individuelle d'un accident (Lucidi, Giannini, Sgalla, Mallia, Devoto et Reichmann, 2014). L'identification précise des causes d'accident est souvent problématique pour les autorités concernées. De plus, Cheng, Ng et Lee (2012) ont noté que l'interdiction de conduire de ces personnes a peu d'effet sur le système global, puisqu'elles ne peuvent constituer qu'une faible proportion de la population des automobilistes (Pelsmacker et Janssens, 2007). De plus, la composition des groupes ayant subi des accidents n'est généralement pas constante d'une année à l'autre (Cannell, 2001).

1.4. Agressivité : origine et définitions

Selon Bacchieri et Barros (2011), il y a un grand nombre d'idées différentes sur l'agressivité, aucune d'entre elles n'étant considérée comme une explication complète, car elles reflètent l'orientation et les exigences des chercheurs qui les ont développées (Bhalla, Sarre, Redlich, Tinker, Sadler et McKevitt 2014).

Les théories biologiques considèrent ce comportement comme quelque chose d'inné, bien que les réponses spécifiques soient modifiées par l'expérience (Bartholomeu, 2008). Pour l'analyse psychanalytique traditionnelle, l'hypothèse de frustration-agression suggère que l'origine de l'agressivité réside dans les comportements qui doivent se trouver dans les facteurs externes (Hoffmann & González, 2003). Il y a la théorie de l'apprentissage social dans laquelle l'agression est une réponse par l'observation ou l'imitation d'autres personnes socialement pertinentes (Bacchieri et Barros, 2011). L'agressivité selon Winnicott (2000), qui résulte de l'addition des normes sociales, des récompenses, des punitions, est la motilité de l'être humain et qu'un acte agressif est influencé par l'environnement externe dans lequel un individu est exposé (Fadiman, 2017).

Lajunen (2001) souligne que les variables étudiées du comportement humain ont tendance à se différencier selon qu'elles mettent l'accent sur le rôle des processus (hérédité génétique et évolutionnaire) et de l'expérience (apprentissage par l'exposition à des facteurs environne-mentaux), et le comportement agressif est le résultat de l'interaction de ces facteurs.

Selon Fadiman (2017), la définition de la conduite agressive peut être tout comportement visant à provoquer des blessures physiques ou mentales. Le concept d'intention est utile pour distinguer entre les actes intentionnels, où l'intention était de nuire à autrui, et les coïncidences, qui révèlent une volonté, avec des résultats dangereux, pour satisfaire les motivations du conducteur (Fadiman, 2017; & Rundmo, 2002). Cette dernière situation implique nécessairement des comportements dans lesquels le conducteur n'a pas l'intention de nuire aux autres usagers de la route et peut ne pas être conscient des risques encourus (Bartholomeu, 2008). Ce comportement de conduite est agressif en apparence mais n'implique pas nécessairement l'intention de causer des dommages, bien qu'il puisse par la suite mettre en danger d'autres usagers de la route (Vallières, Bergeron et Vallerand, 2005).

Selon González-Iglesias, Gómez-Fraguela et Luengo-Martín (2012), le comportement des usagers de la route, dont l'agression est un aspect, doit être considéré dans le contexte social et psychologique dans lequel il se déroule. Dans ce cas, le comportement de l'usager de la route est considéré comme reflétant l'équilibre des motivations (par exemple, le désir d'accélérer ou d'obtenir une meilleure position dans le flux de circulation) et le risque subjectif d'implication dans une collision. Selon Naatanen et Summala (1974, 1976), le point central est le fait que les conducteurs ne perçoivent généralement pas le risque d'être impliqué dans un accident. Cette absence de perception du risque d'être impliqué-e-s dans les accidents permet aux conducteurs d'assister à d'autres types de besoins tels que le gain de temps (Naatanen & Summala, 1974, 1976).

Le concept de perception du risque a différentes implications pour le risque du conducteur, l'un d'entre eux comme dans la théorie de l'homéostasie du risque (Wilde, 1982, 1994). Selon le concept d'homéostasie du risque, les usagers de la route recherchent un niveau constant de risque qu'ils se préparent à retrouver s'ils se sentent en sécurité. Cette théorie suppose que le conducteur est conscient et désire le niveau de risque qu'il prend (González-Iglesias et al., 2012).

D'autres facteurs peuvent également influencer les comportements agressifs ou à risque au volant tels que le stress et l'alcool (Oliveira, 2008). Les recherches se sont concentrées sur l'évaluation des variables de personnalité, mesurées par des tests, afin de prédire les comportements de conduite agressifs (Deffenbacher, Lynch et al., 2002, Villieux et Delhomme, 2010; Dahlen et al., 2005). Ils se sont efforcés d'expliquer la relation entre la conduite agressive et les accidents de la route (Féris, 2003; Heckman, Stixrud & Urzua, 2006). Silva (2008) a expliqué que la conduite agressive peut concerner davantage les membres de la conduite «normale» que le conducteur déviant qui ne peut pas ou ne veut pas contrôler son agressivité.

Des chercheurs tels que Naatanen et Summala (1976) ont suggéré que la frustration peut expliquer l'apparition de comportements agressifs dans certains cas. Selon Gold (2003), l'hypothèse de frustration-agression propose que les individus doivent se décharger de leurs sentiments de frustration. Une personne qui n'a pas trouvé des façons appropriées de faire face à la frustration ou à l'angoisse peut entrer dans une conduite futile et tenter de prendre le contrôle (Yamada, 2005). Étant donné la nature souvent frustrante de la conduite, il n'est peut-être pas surprenant que certains conducteurs soient agressifs face aux situations difficiles auxquelles ils sont confrontés au quotidien (Naatanen et Summala, 1976, Silva, 2006, Yamada, 2005). La contribution de l'agression dans les accidents de la route est de 0,6 pour cent pour la frustration ou l'agression et de 1,6 pour cent pour la conduite imprudente (Jovanovic et al., 2011).

Une autre explication possible du comportement agressif est que la voiture isole essentiellement le conducteur des autres usagers de la route. En outre, la conception de l'automobile offre une certaine immunité contre les représailles (Moeller, Barratt, Dougherty, Schmitz et Swann, 2001). Par conséquent, les propriétaires de véhicules se sentent moins contraints de révéler des dispositions agressives. Dans le cas contraire, lorsque l'agressivité est utilisée pour défendre le domicile, si le nombre de propriétaires de voitures augmente, il peut se produire une agression «pour promouvoir le sens des droits de propriété du conducteur» (Gosling, Rentfrow et Swann, 2003). Pour le jeune conducteur qui, en général, a peu de biens immobiliers, le véhicule automobile devient un symbole de pouvoir et de prestige, une partie de son territoire à défendre des expositions agressives qui menacent ou violent son intégrité.

Comme l'a observé Gold (2003), l'agressivité chez les êtres humains est façonnée par des normes et des valeurs sociales. Il se peut que les valeurs sociales influencent les attitudes à l'égard de la conduite agressive et du comportement (Yamada, 2005). L'apprentissage peut aussi influencer les situations et les moyens par lesquels les sentiments de frustration et d'agressivité sont exprimés (Lamounier & Rueda, 2005). Cependant, toutes ces observations doivent rester spéculatives par manque de preuves. Les bases de l'agressivité sont très complexes et se produisent probablement en raison d'une combinaison de facteurs biologiques, sociaux et comportementaux (Coie et Dodge, 2000).

Par conséquent, l'intégration des facteurs biologiques, sociaux et comportementaux dans cette perspective implique de pouvoir explorer la position subjective des conducteurs, avec leurs évaluations personnelles, leur personnalité (Cuffa 2016). En outre, il faut explorer les motivations psychologiques du conducteur et leurs barrières ainsi que les comportements psychologiques pour réduire l'impact de l'agressivité et assurer une conduite écologique durable (Jacobi, 2003). En raison de ses caractéristiques écologiques, sociales et durables, l'éco-conduite peut apporter aux conducteurs une réponse pour améliorer les problèmes de circulation actuels (conduite agressive) (Ueba, Ledesma & Montes, 2010). En outre, Fernandez (2013) a suggéré que l'ancrage motive de nouveaux comportements qui encouragent la conduite prudente et calme.

Selon Monteiro et Günther (2006), une compréhension plus approfondie du contexte dans lequel la conduite agressive se produit est nécessaire. Les stratégies possibles pour gérer la conduite agressive comprennent le contrôle des conducteurs et la modification du comportement du conducteur (De Young, 2010; 2014). Mais, comme l'ont observé Nunes, Chapman et Crundall (2010), toute initiative visant à lutter contre l'agressivité au volant doit nécessairement prendre en compte l'approche théorique adoptée. Il y a peu de doute qu'il existe un composante d'apprentissage (au moins dans les formes et les situations dans lesquelles l'agression est exprimée) sur le comportement agressif (Gold, 2003). Et, à ce sujet, la société dans son ensemble détermine le niveau des marges de sécurité et de son apprentissage. La prise en compte des risques et de la compétitivité peut en partie être encouragée par la société (Nunes et al., 2010; Costa et McCrae, 2007).

Comme l'a recommandé Gold (2003), les dommages causés par l'agressivité sur les routes peuvent être limités en mettant l'accent sur une culture d'éco-conduite qui encourage les automobilistes à adopter des réactions plus sédentaires et raisonnables sur la route. La réduction du stress chez les conducteurs peut également contribuer à faire en sorte que les conducteurs acceptent et respectent les lois et la réglementation (Cuffa, 2016).

1.5. L'éco-conduite

Le style d'éco-conduite offre de nombreux avantages. Il permet non seulement d'économiser du carburant et des coûts, mais améliore également la sécurité ainsi que la qualité de l'environnement national et mondial (Kurani, McCarthy & Yang 2010). Selon une large enquête de Fiat (5 700 conducteurs dans cinq pays), l'éco-conduite permet d'économiser en moyenne 15% des coûts de carburant (Mannering, 2009). Compte tenu du kilométrage moyen des voitures de 12 285 km/an, de la consommation moyenne de 7,3 litres/100 km et du coût moyen du carburant de 1 43 euros le litre, cela correspond à une économie annuelle de 192,5 euros pour le conducteur. L'éco-conduite réduit non seulement les coûts de carburant, mais aussi les coûts d'entretien des véhicules et les coûts de réparation de la voiture. Les éco-conducteurs usent moins les composants de leur voiture (pneus, freins et moteurs) et sont moins sujets aux accidents (Wahlberg, 2007).

Le comportement de conduite le plus sûr peut être considéré comme l'anticipation des événements de la route, ce qui signifie moins d'accélération et de freinage, moins de vitesse et de dépassement, et un impact de conduite moins stressant et agressif en général (Pelsmacker et Janssens, 2007). C'est l'éco-conduite. De plus, l'éco-conduite assure une conduite plus détendue au volant et offre un certain nombre d'avantages pour la santé aux conducteurs et peut améliorer la satisfaction du conducteur (Kurani et Stillwater, 2011). Selon une étude portant sur la formation à l'éco-conduite à la Hamburg Water Company, le coût des accidents de voiture a diminué de 40% après la formation. L'éco-conduite est principalement mise en œuvre par les conducteurs qui adoptent une grande interdistance avec la voiture qui les précède (Pelsmacker & Janssens, 2007).

Pour Jacobi (2003), les conducteurs pratiquant l'éco-conduite ne mettent pas plus de temps à atteindre leur destination, mais sont souvent encore plus rapides. Ceci est principalement dû à l'accélération de la circulation et évite ainsi les arrêts (Kurani & Stillwater, 2011). L'éco-conduite est également respectueuse de l'environnement (Kahneman, 2011) parce que le style de conduite a un impact sur le bruit généré par les véhicules et le carburant, et dans un monde où les températures montent et où les experts disent que l'environnement est menacé par les émissions causées par le dioxyde de carbone (CO2) (Jacobi, 2003), c'est une stratégie prometteuse.

L'une des façons de réduire les émissions consiste à conduire de manière plus respectueuse de l'environnement et à réduire la consommation de carburant pour parcourir la même distance (Stillwater, 2011). En conséquence, les mesures visant à améliorer les comportements de conduite favorisent l'économie de carburant et, par conséquent, la réduction des émissions de CO2 dues à la circulation. Par conséquent, si l'éco-conduite devient la norme plutôt que l'exception, elle pourrait réduire les émissions du transport routier motorisé (Birrell et Fowkes, 2014).

1.6. Vue d'ensemble de la thèse de doctorat

Entre "l'introduction" et "la discussion générale et la conclusion", cette thèse se compose de deux grandes parties: les aspects théoriques et la recherche empirique. Les aspects théoriques (partie I) comprennent trois chapitres qui donnent un aperçu du programme de recherche.

Ce chapitre, intitulé "Activité de conduite et comportement", donne un aperçu de la compréhension de la phénoménale activité de conduite et comment la conduite est une tâche multifactorielle décrivant les comportements, l'environnement routier, et les aspects cognitifs de l'attention ainsi que l'adaptation des comportements. L'autre chapitre est axé sur les facteurs de personnalité et les états émotionnels qui sont positivement liés aux excès de vitesse. Ce second chapitre comprend deux sections. La première section se centre sur la colère au volant et la seconde sur la recherche de sensations. Le dernier chapitre présente un aperçu du programme de recherche, incluant les questions de recherche et les principales hypothèses. Ce dernier chapitre fait le lien entre les théories présentées dans le chapitre précédent et la partie principale suivante présentant les études empiriques.

La recherche empirique (partie II) est composée de trois chapitres présentant chacune des trois études réalisées dans ce travail. Les deux premières études ont porté sur l'adaptation en portugais de l'échelle DAX dans le contexte brésilien. Nous avons examiné les liens avec les accidents de la circulation et les infractions, ainsi que la recherche de sensations et l'hostilité au volant. Ces études ont été menées auprès de deux populations différentes: la première étude a été menée auprès d'un échantillon d'étudiants de premier cycle, la seconde auprès de conducteurs qui ont perdu le permis de conduire et qui suivent un cours de recyclage pour le récupérer. Ensuite, la troisième et dernière étude se focalise sur les conducteurs professionnels d'une entreprise de Curitiba qui testent une formation à l'éco-conduite afin de réduire la conduite agressive.

Enfin, dans la discussion générale et la conclusion, les résultats de ces trois études concernant les comportements de conduite et les aspects de la personnalité et les implications théoriques et sociétales sont discutés, ainsi que les limites des études et les perspectives de recherches futures.

II Partie empirique

Après avoir rappelé l'objectif central de la thèse, nous décrivons les trois études qui ont été réalisées.

L'objectif principal de cette thèse est d'étudier le rôle de l'agressivité dans la circulation routière au Brésil et d'examiner comment les efforts combinés peuvent réduire son impact pour améliorer la sécurité routière et la mobilité. Pour atteindre cet objectif, trois études ont été réalisées dans la ville de Curitiba, l'une des plus grandes villes du Brésil.

Pasquali (1999) a souligné que le manque d'échelles psychométriques au Brésil constitue une lacune et des obstacles à l'avancement de la recherche scientifique. Lors de l'utilisation d'échelles développées à l'étranger, les difficultés méthodologiques ne sont pas négligeables, telles que la traduction, l'absence d'adaptation de ces tests au contexte brésilien et le test de ces adaptations (Garcia, 1985, Jackson et Warr, 1984, Stafford, Jackson et Banks, 1980, Álvaro-Estramiana, 1992 et García-Rodriguez, 1993). Comme aucun test n'était de fait disponible en portugais pour enregistrer l'agressivité ou la colère au Brésil, nous avons adapté les instruments anglais au contexte brésilien et essayé de les valider.

2.1. Etude 1

Le but de la première étude était de valider l'adaptation brésilienne (DAX-BR) de l'inventaire de l'expression de la colère au volant (DAX, créé par Deffenbacher, Lynch et al., 2002) auprès de jeunes automobilistes universitaires. Nous avons suivi la procédure utilisée par Villieux et Delhomme (2010) qui ont adapté l'échelle DAX en français, c'est-à-dire que nous avons testé la structure factorielle DAX et la fiabilité de ses facteurs et examiné ses relations avec 1) différents types de transgressions et erreurs commises au volant enregistrés par le questionnaire de comportements de conduite (DBQ, Reason et al., 1990; validé en brésilien par Bianchi & Summala, 2002), ainsi que les accidents de la route et 2) d'autres facteurs de personnalité tels que l'Échelle de recherche de sensations au volant (DSSS, Taubman et al., 1996) et l'échelle d'hostilité (Rolland et Petot, 1994). Le questionnaire a été administré à un échantillon de 512 étudiant-e-s de premier cycle (52,1% d'hommes) âgé-e-s de 18 à 40 ans (moyenne = 23,8 ans, S.D. = 5,74). L'analyse factorielle des items du DAX brésilien a donné une solution en quatre facteurs comprenant 43 items, qui a permis d'obtenir la meilleure adéquation aux données. Le DAX-BR présente des scores de fiabilité satisfaisants pour l'échelle globale (α = 83) et ses facteurs (α compris entre 0,88 et 0,69).

il est surprenant que le facteur «Expression adaptative/constructive» de la DAX ait auprès des jeunes automobilistes la moyenne la plus élevée. Nous nous attendions à ce que les facteurs «Utilisation du véhicule pour exprimer la colère» ou «Expression physique agressive» obtiennent le moyenne la plus élevée alors qu'ils ont obtenu les moyennes les plus basses. On s'attendait également à ce qu'il y ait une différence significative selon le sexe pour tous les facteurs DAX-BR, or ce n'est que pour le facteur «Expression adaptative/constructive» que cette différence est significative dans la mesure où les hommes ont tendance à être plus agressifs que les femmes.

En distinguant les types d'accidents actifs et passifs, seuls les accidents actifs (avoir ou ne pas en avoir) permet d'enregistrer des différences significatives pour tous les facteurs de DAX-BR. Dans ces cas, le groupe qui a commis l'accident avait la moyenne la plus élevée, juste pour le facteur d'expression verbale agressive, le groupe ayant subi l'accident avait la moyenne la plus élevée. Par contre, pour les accidents passifs, des différences significatives entre les groupes n'étaient pas attendues car dans ce cas, le conducteur n'a été confronté qu'à des actions. Dans les deux cas, pour les accidents passifs, il y avait des différences significatives pour «l'expression agressive verbale» et «l'utilisation du véhicule pour exprimer la colère», le groupe qui avait subi l'accident avait la moyenne la plus élevée.

Selon le sexe, on a découvert de façon surprenante qu'il existait des différences significatives entre les groupes pour les infractions ordinaires et non pour les infractions agressives, dans la mesure où les hommes ont tendance à être plus agressifs que les femmes (Veiga et al., 2009; Bener et al., 2008, Shi et al., 2010, Winter & Dodou, 2010). Sinon, pour les accidents actifs, il y avait une différence significative pour les infractions ordinaires, les infractions agressives et les erreurs, et le groupe impliqué dans un accident avait les moyennes les plus élevés. En revanche, les différences pour les accidents passifs étaient significatives pour les deux types d'infractions (ordinaires et agressives) et dans ces cas, le groupe qui avait subi un accident avait les moyennes les plus élevés.

En ce qui concerne les amendes, un groupe important avait des différences par rapport aux infractions ordinaires et agressives, et dans les deux cas, le groupe qui avait reçu des amendes avait les moyennes les plus élevées. C'était quelque chose que nous attendions parce que pour recevoir des amendes, le conducteur avait commis des infractions au code de la route.

Idéalement, pour l'échelle d'hostilité nous attendions un meilleur alpha de Cronbach mais il est de 0,61. Il n'a pas eu de problèmes majeurs pour l'adaptation du contexte brésilien de cette échelle puisqu'il s'agit d'une échelle unifactorielle. De plus, il est surprenant qu'il n'y ait pas de différences significatives selon le sexe sur l'échelle d'hostilité, puisque les hommes ont tendance à avoir plus d'hostilité que les femmes (Perepjolkina et Renge, 2011; Sârbescu et al., 2014).

De plus, l'échelle de recherche de sensations au volant (DSSS) a obtenu une bonne fiabilité avec l'alpha de Cronbach de 0,86 et nous avons obtenu les différences attendues pour le sexe, les accidents et les amendes. En ce qui concerne les différences entre les sexes, les hommes ont une moyenne plus élevée, car ils ont tendance à rechercher plus de sensations (Zuckerman et Kuhlman, 2000). Pour les accidents actifs, un chercheur de sensations a tendance à être plus souvent impliqué dans un accident (Peer & Rosenbloom, 2013; Zuckerman, 1994). Enfin, pour les amendes, dans la littérature, les chercheurs de sensations reçoivent davantage d'amendes pour excès de vitesse que les autres groupes (Cestac et al., 2011; Jonah, 1997).

De plus, une corrélation positive élevée entre les facteurs de DAX-BR, du DSSS et du DBQ (allant de 0,39 à 0,59) a fourni une preuve de sa validité mais seulement pour l'expression agressive verbale de DAX-BR. Tandis que le facteur «Utiliser le véhicule pour exprimer la colère» du DAX-BR avait une corrélation moyenne négative avec les échelles d'hostilité, de DSSS et de DBQ.

Pour le DBQ, il était attendu et ceci a été observé dans l'étude 1 que le DAX-BR serait un prédicteur important du DBQ puisque les facteurs du DBQ (infractions ordinaires et agressives) décrivent les comportements d'infractions. Tandis que pour les amendes et les accidents, le DAX-BR n'a pas fonctionné comme un prédicteur fiable. Peut-être parce que l'échantillon provient uniquement du contexte universitaire et que parfois les étudiant-e-s ne conduisent pas avec régularité, ils conduisent moins et ont moins de risques d'être impliqués dans un accident et reçoivent moins d'amendes puisqu'ils sont moins exposés en tant que conducteurs.

Ce DAX-BR peut être recommandé pour l'évaluation de l'expression de la colère au volant chez les jeunes automobilistes brésiliens.

2.2. Etude 2

Une deuxième étude a été menée pour fournir une plus grande validité du DAX-BR. Cette deuxième étude était axée sur une population de conducteurs qui suivaient des cours de recyclage pour retrouver le droit de conduire. Ils ont perdu leur permis de conduire car ils étaient auparavant des conducteurs plus agressifs puisqu'ils avaient commis de nombreuses infractions et avaient reçu plusieurs amendes, principalement pour excès de vitesse, téléphoné au volant et franchi le feu rouge (Detran-PR, 2014). Un questionnaire a été réalisé auprès de 602 conducteurs âgés de 21 à 85 ans (M = 39,3 ans, S.D. = 12,91, 75,3% d'hommes). Dans cette étude, les items du facteur d'expression adaptative/constructive sont restés inchangés, car ils ont obtenu un bon ajustement dans l'analyse factorielle confirmatoire. Cependant, les trois autres facteurs ont été redistribués en deux nouveaux facteurs: verbal et physique, ainsi que projectif, car aucun bon paramètre psychométrique n'a été trouvé dans l'utilisation de la structure originale. L'alpha de Cronbach de l'échelle globale était de 0,85. Des corrélations positives ont été trouvées entre le facteur expression adaptative/constructive du DAX-BR et les échelles du DBQ (infractions ordinaires, $r = 0.45$, infractions agressives, $r = 0.48$).

Dans la deuxième étude, il n'y avait pas de différences significatives selon le sexe pour les facteurs DAX-BR. En ce qui concerne les accidents actifs, il y avait des différences significatives entre les groupes sur le facteur «verbale et physique», et le groupe impliqué dans les accidents avait la moyenne la plus élevée. En ce qui concerne les accidents passifs, il y avait des différences significatives entre les groupes pour le facteur «verbale et physique» et le groupe ayant subi les accidents avait la moyenne la plus élevée. Pour les amendes, il y avait des différences significatives entre les groupes pour les facteurs «verbal et physique» et «projectif» du DAX-BR, et le groupe qui avait reçu les amendes avait la moyenne la plus élevée.

Il y avait des différences significatives entre les groupes sur les erreurs et les infractions ordinaires selon le sexe, et dans les deux cas, les hommes ayant commis des erreurs et des infractions ordinaires avaient les moyennes les plus élevées.

Les infractions agressives avaient les moyennes les plus élevées que les infractions ordinaires, mais leurs moyennes sont faibles.

Pour les accidents actifs, il existait des différences significatives entre les groupes en ce qui concerne les infractions ordinaires et les infractions agressives, et dans les deux cas, le groupe impliqué dans un accident avait la moyenne la plus élevée. Pour les accidents passifs, il y avait des différences significatives entre les groupes en ce qui concerne les infractions ordinaires et les infractions agressives, et dans les deux cas, le groupe ayant commis l'accident avait la moyenne la plus élevée.

Sur le plan des amendes, il y avait des différences significatives entre les groupes dans les infractions ordinaires et le groupe qui avait reçu une amende avait la moyenne la plus élevée.

Comme noud l'avions prédit, il y a des différences significatives entre les groupes à l'échelle de recherche de sensations au volant (DSSS), en raison du sexe et des accidents actifs, parce que les hommes ayant une moyenne élevée au DSSS sont plus impliqués dans les accidents (Zuckerman et Kuhlman, 2000). Des corrélations positives plus importantes étaient attendues entre les facteurs DAX-BR et d'autres échelles, mais elles n'ont pas été trouvées. Nous n'avons trouvé que des corrélations positives moyennes entre le facteur «Expression Adaptative/Constructive» du DAX-BR et les infractions ordinaires (DBQ). Pour les trois facteurs de DBQ, le DAX-BR était un bon prédicteur.

Enfin, on s'attendait à ce que les participants de la deuxième étude aient une moyenne plus élevée aux facteurs du DBQ que les participants de la première étude, parce que les premiers constituent un échantillon plus infractionnistes que les seconds, mais le contraire a été observé.

2.3. Etude 3

L'idée de cette troisième étude était de réduire l'impact de l'agressivité sur les comportements du conducteur et d'inciter les conducteurs à pratiquer l'éco-conduite (maintenir autant que possible au volant une vitesse constante, anticiper le flux de circulation et accélérer et décélérer en douceur). Le style d'éco-conduite requis est à adopter de façon sécuritaire en fonction de la gestion des interactions avec les usagers et des situations routières (Dogan, Steg et Delhomme, 2011). Selon cette approche d'éco-conduite, le conducteur qui a suivi une formation a tendance à éviter les freinages violents et les accélérations brusques, ce qui lui permet de réaliser des économies (diminution de la consommation de carburant), de polluer moins et d'avoir des réactions moins agressives à travers l'anticipation des événements de la route. L'objectif de la troisième étude était de tester l'effet de la formation d'un groupe de conducteurs pour obtenir un profil d'éco-conduite contrôlant les comportements agressifs de la circulation. Dix conducteurs ont été sélectionnés, par le biais du volontariat, avec cinq conducteurs venant de deux départements différents d'une entreprise qui assure des services d'entretien pour la ville de Curitiba. Tous les participants étaient des hommes. L'âge moyen était de 34,40 ans (S.D. = 7,90, écart = 26 à 50). Un plan avant-après avec des groupes expérimental (éco-conduite) et contrôle a été utilisée. Chaque groupe avait cinq conducteurs. Avant de commencer la collecte des données, toutes les voitures ont été examinées pour les performances optimales (pression des pneus, réparations mécaniques) avant et après la conduite. Une fois ces conditions préalables, les participants ont conduit sur route pendant cinq jours dans la ville. Les participants des deux groupes ont été invités à respecter les limites de vitesse et à respecter toutes les règles de circulation et les panneaux de signalisation. A la fin des trajets effectués sur route, les participants ont répondu à un questionnaire. L'expérience a commencé avec la formation de tous les conducteurs. Les dix conducteurs ont reçu des cours individuels pendant huit heures. Pour le groupe expérimental, l'entraînement était axé sur les stratégies pour éviter les freinages violents et les accélérations brusques, comment prendre des décisions pour éviter les événements dans le flux de circulation et l'idée de conduire à vitesse constante. Pour le groupe contrôle, la formation était axée sur un entraînement de sécurité en général. Après l'expérience, le groupe témoin a reçu la même formation qui a été donnée au groupe expérimental. Une étude a été réalisée où les données avant la formation (référence) et celles collectées après la formation étaient comparées au style de conduite chez les conducteurs. Le groupe expérimental a réduit la consommation de carburant de 11,1% et a évité les accélérations brusques et les coups de freins violents. Le groupe contrôle a, quant à lui, conservé les mêmes comportements qu'il avait entrepris lors de la phase de référence.

III Discussion et conclusion

Pour conclure, l'utilisation de l'échelle DAX peut être une ressource importante combinée à d'autres instruments tels que DBQ, DSSS et l'échelle d'hostilité pour mesurer le comportement agressif des conducteurs. Selon Benfield, Szlemko et Bell (2007), les variables de personnalité telles que l'impulsivité, la recherche de sensations et la prise de risque sont liées aux comportements agressifs et à risque tels que les infractions et les excès de vitesse. Combinées à d'autres stratégies, les variables de personnalité et l'état émotionnel (comme la colère et l'agressivité en réaction à un événement sur la route) ont contribué à la mise en œuvre de modèles de conduite plus efficients comme l'éco-conduite pour les automobilistes brésiliens.

3.1. Implications théoriques

Les traits de personnalité ne peuvent pas être observés directement. Donc, il faut des instruments tels que des tests, des échelles et des questionnaires pour mesurer ces traits de personnalité. Cela entrave souvent les stratégies d'intervention de conception qui visent à fournir des solutions aux comportements agressifs. La première tentative de caractérisation formelle des phénomènes de conduite agressive a été faite par Tasca (2000) en décrivant la conduite agressive ainsi «elle est délibérée, susceptible d'augmenter le risque de collision et motivée par l'impatience, l'agacement, l'hostilité et/ou tenter de gagner du temps. "Depuis Tasca (2002), plusieurs études ont tenté d'expliquer cela. Galovski et Blanchard (2002) ont utilisé une définition relativement étroite comme un comportement destiné à blesser autrui, tandis que certains auteurs ont donné une définition plus large comme un acte qui néglige ou viole la sécurité avec ou sans intention de mettre en danger les autres (AAA Foundation for Traffic Safety, 2009, Deffenbacher, Filetti, Lynch, Dahlen et Oetting, 2002, Galovski, Blanchard, Malte et Freidenberg, 2003).

Les résultats de Galovski et Blanchard (2002) ont plusieurs implications théoriques. Dans la première partie de cette thèse, le cadre théorique s'est centré sur la conceptualisation du phénomène de la colère et de l'accident. En général, la colère et les accidents sont mesurés ensemble (Ferreira et al., 2010; Bolson et al., 2011; González-Iglesias et al., 2012).

La conceptualisation et les théories sur l'agressivité du conducteur tentent toujours de trouver des façons de comprendre et de réduire l'impact de la colère en conduisant. Plus précisément, la conceptualisation de la représentation de la colère et de la représentation sociale s'intéressent principalement au contenu de la représentation et à la façon dont les représentations sont créées ou dans sa structure, en particulier pour la représentation sociale (Tasca, 2000).

Généralement, les théories sur les comportements sont développées autour d'un modèle et centrées sur la relation entre les contextes et le comportement. Comme l'a observé Tasca (2000), les modèles incluent souvent plusieurs facteurs comme prédicteurs d'un comportement spécifique. Ajzen (1975) a fait une distinction entre les attitudes et d'autres concepts, tels que les croyances et les intentions comportementales. Selon cet auteur, l'attitude correspond principalement aux émotions positives ou négatives vis-à-vis de l'objet attitudinal (Ajzen, 1975). Pour nous, la caractéristique évaluative des attitudes fait partie de la représentation, mais l'idée principale qui définit notre concept de représentation est le concept de Perugini et Bagozzi (2004) utilisé comme croyance, se référant à l'information, la connaissance ou les opinions sur l'objet d'attitude. L'intention est différente de la motivation dans la théorie du comportement planifié (TPB, Ajzen, 1985). Le comportement agressif a plusieurs paramètres; il peut être exprimé par la voiture au moyen de mouvements d'attaque ou de fuite; par l'émotion ou par hostilité à l'égard d'une autre personne essayant d'exprimer le contrôle sur l'autre (Fariz et al., 2005; Barros et Silva, 2006). L'hostilité est un élément qui incite souvent le conducteur à commettre des infractions aux règles et provoque des accidents de la circulation (Villieux et Delhomme, 2008).

Parmi les facteurs émotionnels, la colère reflète une prédisposition à ressentir de la colère plus souvent en conduisant. Par conséquent, la colère se réfère à la propension à s'énerver en conduisant (Deffenbacher et al., 2003). La colère au volant pourrait être considérée comme un facteur important dans la prédiction du comportement à risque sur la route, par rapport à d'autres facteurs de personnalité tels que la recherche de sensations, l'impulsivité et l'hostilité (Dahlen et al., 2005; Villieux et Delhomme, 2010). La colère peut générer des comportements à risque, notamment pour les jeunes conducteurs, ce qui peut expliquer leur implication dans un plus grand nombre d'accidents de la route.

De même, les cadres théoriques centrés sur le processus cognitif et affectif ont eu un impact considérable sur la situation de la conduite agressive. Le modèle de Vallières, Bergeron et Vallerand (2005) développe ces idées autour de l'interaction agressive de conduite entre deux conducteurs, il ont émis l'hypothèse selon laquelle plus un conducteur perçoit le comportement comme intentionnel, plus cela augmentera sa colère.

De plus, selon les caractéristiques psychologiques, l'être humain réagit différemment lorsqu'il est soumis à des situations différentes et, dans la plupart des cas, il est facilement agité s'il est légèrement provoqué (Weiner, 2001). Ce facteur peut être lié aux problèmes familiaux, au travail et à l'interaction de différentes personnes de différents groupes ethniques ou de différentes nationalités.

Le modèle adopté dans cette étude soutient l'idée que le comportement, les traits de personnalité et les états émotionnels sont liés. En ce sens, le modèle permet un point de vue général concernant l'implication d'autres variables qui pourraient être prises en compte dans les études futures.

Dans cette thèse, l'accent était mis sur la mesure des dimensions de la colère et des accidents, principalement parce que les deux concepts représentent des variables qui peuvent faire la différence entre être mort ou vivant. En ce sens, il semble important d'étudier ces deux concepts et les caractéristiques des autres conducteurs.

Les résultats de la première étude appuient fortement les hypothèses de l'étude selon lesquelles les jeunes conducteurs ont tendance à être plus agressifs que les conducteurs plus âgés. Notre conclusion est dans la lignée de plusieurs auteurs (Marín-León et al., 2003), Maxwell et al., 2005, Simons-Morton et al., 2012, Krahé, 2013).

Concernant le cadre théorique utilisé dans la deuxième partie de ce doctorat, l'agressivité en général et l'agressivité perçue en particulier, sont des concepts plutôt nouveaux pour l'étude des conducteurs au Brésil; de plus, la conduite agressive est considérée comme une forme d'agressivité commune dans la vie de tous les jours (Krahé, 2013). L'étude a donc innové lorsqu'elle s'est appliquée à la perception de l'agression dans l'interaction entre les automobilistes et à trouver un moyen de réduire son impact par l'éco-conduite. De plus, l'étude a porté sur le point de vue du conducteur, en utilisant le concept d'agressivité perçue de Baron et Richardson (1994) pour identifier le rôle de l'intention de définir l'agressivité du point de vue de la «victime».

Dans la troisième étude, nous avons apporté une contribution précieuse, car l'étude sur l'éco-conduite a contribué à réduire l'impact du comportement agressif des conducteurs et à promouvoir l'économie de carburant. Cependant, il est nécessaire de travailler avec le conducteur sur les dimensions tactiques et comportementales, par exemple: le temps de conduite, l'itinéraire à prendre, la stratégie (conduire avec une voiture plus légère) et les décisions opérationnelles du conducteur (activité de conduite).

3.2. Implications societales

Pour la société, nos études contribuent à placer le conducteur au centre de la réflexion, en réunissant la personnalité et le comportement dans une approche plus intégrative; dans laquelle les facteurs internes et les facteurs externes sont complémentaires. En ce sens, les études ont réalisé une avancée sur le plan des facteurs individuels.

L'étude a utilisé deux concepts pour différencier les processus : d'une part, les adaptations instrumentales qui nous renseignent sur les comportements agressifs, et d'autre part, l'étude pratique qui réduit l'impact de la colère sur le comportement. De même, les deux premières études donnent des résultats différents de deux types d'échantillons. De même, l'étude a permis d'identifier les points négatifs qui doivent être corrigés ou améliorés, à la fois pour l'individu (pour le lecteur qui utilise DAX-BR, en tant qu'évaluation personnelle) et pour le bénéfice sociétal. Les résultats peuvent être utiles aux parties prenantes et aux autorités publiques dans la mise en œuvre de la communication avec les résultats de données pour les campagnes de sensibilisation ainsi que dans la formation des conducteurs pour obtenir par conséquent un meilleur comportement.

Pour mettre efficacement en œuvre l'objectif de réduire l'impact social de la colère, il est conseillé de comprendre les causes et la perception de l'agressivité; à travers cela, nous sommes en mesure de comprendre la source de la conduite agressive. En outre, d'autres stratégies peuvent renforcer les directives punitives ou développer des programmes de sensibilisation, ce sont des recommandations suggérées par la NHTSA (2001).

Au cours des 20 dernières années, des enquêtes sont en cours d'élaboration, des vidéos sont en cours de création, des études sont en cours, des cours de formation sont enseignés, plus de livres sont écrits, plus d'informations sont disponibles sur Internet pour mieux comprendre le problème de l'agressivité (James & Nahl, 2000, 2001). Les résultats obtenus pourraient également aider à développer des actions basées sur l'éducation et la pédagogie concernant les comportements adaptés sur les situations de route conflictuelles. Par exemple, les automobilistes qui, dans le cas d'une collision, ont le plus grand potentiel de nuire à autrui, en réponse à un comportement précédemment perçu comme agressif, pourraient être changés pour être «apprivoisés» grâce à une formation et une éducation appropriées. Dans l'ensemble, l'éducation pourrait aider à décoder la source des conflits entre les conducteurs. Il est également important d'informer et de communiquer sur ces difficultés sur la route et les facteurs qui y contribuent tels que l'intention perçue du comportement du conducteur, le danger perçu de la situation et la représentation sociale.

3.3. Limites des études

La taille de l'échantillon de la première étude et l'homogénéité de l'échantillon pourraient être considérées comme une limite majeure de cette étude. Cependant, le but de cette étude était de valider les échelles.

En ce qui concerne les limites de la deuxième étude, le questionnaire était le même que le premier, mais il était nécessaire d'utiliser une autre structure factorielle pour le DAX-BR. On s'attendait à utiliser la même structure dans les deux études pour différents types d'échantillons, l'utilisation de différentes structures d'instruments était nécessaire. Cependant, pour ce type de population, il est nécessaire de réaliser plusieurs études en utilisant l'échelle DAX-BR. Il est important de faire attention à l'utilisation de DAX-BR, puisque la structure DAX-BR n'a pas complètement fonctionné pour ce type d'échantillon.

Une autre limitation de cette étude provient du fait qu'elle ne mesurait que les composantes comportementales de l'agression. Buss et Perry (1992) ont noté que l'agressivité des traits dans une large mesure implique des caractéristiques affectives et cognitives. Cependant, l'étude n'a pas mesuré l'intention ou les motivations conduisant à l'agressivité du conducteur. Par conséquent, la recherche future doit examiner les facteurs de motivation qui sous-tendent l'agressivité du conducteur actif et passif.

De plus, l'agressivité du conducteur ne se produit pas isolément, mais elle est déterminée par des aspects de l'environnement instigateur tels que la provocation des autres conducteurs et les embouteillages (Hennessy, 1999). Parce que conduire une voiture est une activité dynamique qui implique de prendre des décisions rapidement, comme Vallières et al. (2005) précisant que si un conducteur perçoit n'importe quel type d'intentions de la part du comportement d'un automobiliste, il peut commencer à adopter un comportement agressif pour exprimer sa colère envers cet automobiliste.

Enfin, les limites de la troisième étude étaient la taille de l'échantillon, seulement avec dix conducteurs, et le fait que les conducteurs travaillent quotidiennement sur différentes routes, donc il était plus difficile de contrôler les variables, par exemple dans d'autres études sur l'éco-conduite par les chauffeurs de bus, ces conducteurs font quotidiennement le même traject. Un point à considérer à l'avenir est que, puisque ces conducteurs travaillent pour une entreprise, les conducteurs pouvaient manifester un comportement plus contrôlé pendant qu'ils conduisaient dans la voiture de l'entreprise. Un autre point dans cette étude est qu'il n'y a pas de groupe de conductrices pour comparer les effets de sexe. Ceci est important parce que des recherches indiquent que l'âge est négativement lié à la fois à l'agression (Sârbescu, 2012) et à la vengeance (Romano et al., 2012). Le dernier est légèrement élevé chez les conductrices (Simon et Corbett, 1996; Lonczak, 2007). Par conséquent, les conducteurs plus jeunes se livrent généralement à des représailles, comme la poursuite d'une autre voiture, la conduite d'un autre automobiliste et la participation à une agressivité verbale tout comme les conducteurs plus âgés.

Un autre point est que cette recherche porte sur la désirabilité sociale. Il y avait des questions qui incluent un comportement de conduite agressif et dangereux qui obligeait le répondant à divulguer ses engagements dans la conduite illégale comme l'utilisation du téléphone cellulaire pendant la conduite, la rage au volant et la vitesse, mais quelque chose que les participants pourraient avoir peur ou avec honte de rapporter dans le questionnaire.

Après avoir mené ces trois études, nous pouvons souligner quelques perspectives pour la recherche future. A partir de l'étude 1, on a montré des preuves de la validité de l'échelle DAX-BR pour l'utiliser dans les recherches futures. Ces preuves sont la bonne fiabilité, le maintien de la structure originale des facteurs dans la première étude, la corrélation positive avec d'autres facteurs d'autres instruments utilisés comme le DBQ et l'utilisation du DAX-BR comme prédicteur d'infractions et d'erreurs. Comme idée pour des études ultérieures de la validité du DAX-BR, il pourrait être adapté pour être utilisé au moyen d'un questionnaire électronique, afin d'obtenir un plus grand échantillon. De la deuxième étude, il peut être utilisé dans la structure finale du DAX-BR, trouvée avec trois facteurs stables, pour étudier les conducteurs sérieux. L'utilisation de DAX-BR avec les conducteurs délinquants peut aider à l'étude des conducteurs agressifs au volant et des conducteurs délinquants, et cette validation de l'instrument pourrait aider à rendre ce genre de recherche plus populaire. Une autre étude utilisant DAX-BR pourrait être celle des conducteurs qui ont besoin de renouveler le droit de conduire, ce qui se produit habituellement tous les cinq ans, de sorte que nous aurions des résultats avec les conducteurs qui conduisent fréquemment. De plus, l'instrument pourrait être associé à d'autres instruments de personnalité tels que le Locus of Control, ou des échelles de personnalité comme les Big Five, ou la DAS, comme c'est souvent le cas dans d'autres pays. Dans la troisième étude, les résultats peuvent amener d'autres entreprises à demander plus fréquemment à ce type de formation, le programme d'éco-conduite, mais la recherche peut tirer des leçons des difficultés que nous avons eues dans cette étude à obtenir des données comportementales; une autre façon serait d'utiliser l'aide électronique des ordinateurs de voiture ou des systèmes embarqués.

Dans la plupart des cas, la recherche sur la conduite agressive s'est centrée sur l'examen des aspects de la personnalité tels que l'impulsivité et la colère au volant, ce fut le cas dans cette étude.

Pour améliorer le DAX-BR, il est fortement recommandé d'étudier avec les délinquants les raisons pour lesquelles les aspects des facteurs «Utilisation de la voiture et de l'agressivité physique» et «Utilisation de la voiture pour exprimer la colère» n'ont pas fonctionné correctement. Comme le montrent les autres études (Sarbescu, 2012, Villieux et Delhomme, 2010, Sullman, 2015, Stephens et Sullman, 2014), l'utilisation du DAX devrait être plus courante que l'utilisation de la voiture pour montrer la colère, mais plus de recherches sont nécessaires pour soutenir cette explication.

Il est fortement recommandé pour les futures recherches de se centrer sur le style éco-conducteur pour les conducteurs professionnels, puisque ce type de conducteur effectue de plus grandes distances tous les jours, alors les avantages que le style d'éco-conduite apporte normalement aura un plus grand impact pour eux et pour la société.

Dans l'ensemble, il faudrait étudier les comportements de conduite agressifs et les mesures pratiques pour réduire l'impact de l'agressivité dans la conduite. À l'avenir, la recherche devrait prendre en compte la combinaison de mesures d'auto-déclaration (DAX-BR) et d'interventions pratiques dans les simulateurs de conduite pour la formation à l'éco-conduite, afin que les changements de comportement puissent être plus rapides et plus contrôlés. Puisque les simulateurs de conduite sont maintenant plus accessibles au Brésil, la loi prévoit qu'ils soient présents dans les écoles de conduite, ce type de recherche est maintenant possible. Donc, beaucoup de travail est nécessaire sur ce sujet avant d'introduire des véhicules entièrement autonomes sur les routes.

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DOCTORAL THESIS

to obtain the degree of
Doctor of Psychology

DRIVING ANGER AMONG MOTORISTS ON BRAZILIAN ROADS AND ECO-DRIVING AS A WAY TO REDUCE ANGER.

COLÈRE AU VOLANT CHEZ LES AUTOMOBILISTES SUR LES ROUTES BRÉSILIENNES ET ÉCO-CONDUITE COMME UNE FAÇON DE RÉDUIRE LA COLÈRE.

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LONG ABSTRACT

Aggressiveness in social psychology is described as a behavior that aims to harm another individual (Ames & Fiske, 2013) usually dependent on the perception, that is, consciousness (of something or person), impression or intuition (Batista, 2005). Baron and Richardson (1994) noted that what is considered aggressive to one individual may not be to another. On many occasions, the damage caused by intentional aggressive actions is perceived to be worse than unintentional damage even in situations where the outcome of actions is identical (Ames & Fiske, 2013). Aggressiveness can be a personality trait, and can also be an emotional state in reaction to an event (Delhomme & Simoes, 2017).

In Brazil, aggressiveness in traffic is a big issue and could be an important contributing factor to the high rate of traffic accidents. The country has an average of 23.4 traffic accidents per 100,000 inhabitants compared to Europe where the average number is estimated to be 7.8 traffic accidents per 100,000 inhabitants. According to the World Health Organization (2013), the number is the highest average in America with more than 41,000 deaths per year from traffic accidents. The central objective of this PhD thesis is to study the role of aggressiveness in road traffic in Brazil and to examine how combined efforts can reduce its impact to improve road safety and mobility. To attain this objective, three studies were carried out in the city of Curitiba, one of the biggest cities of Brazil. As no instruments were available in Portuguese to register driving aggressiveness or driving anger in Brazil, we have adapted English instruments into the Brazilian context and tried to validate them.

The aim of the first study was to validate the Brazilian adaptation (DAX-BR) of a Driving Anger Expression Inventory (DAX, created by Deffenbacher, Lynch et al. 2002), among young University drivers. We followed the procedure used by Villieux and Delhomme (2010) who adapted the DAX scale in French, that is to say we tested the DAX factorial structure and the reliability of its factors and examined its relationships with 1) different types of transgressions and errors committed while driving registered by Driving Behavior Questionnaire (DBQ, Reason et al., 1990; validated in Brazil by Bianchi & Summala, 2002), as well as traffic accidents and 2) other personality factors such as the Driving-related Sensation-Seeking Scale (DSSS, Taubman et al., 1996), and the Hostility Scale (Rolland & Petot, 1994). The questionnaire was administered to a sample of 512 undergraduate students (52.1% males) aged 18-40 years (mean = 23.8 years, S.D. = 5.74). Factor analysis of the Brazilian DAX items yielded a four factors solution in 43 items, which obtained better goodness-of-fit to the data. The DAX BR has satisfactory reliability scores for the total scale (α= 83) and factors (α ranged from .88 to .69). Also, a strong positive relationship between the factors of DAX-BR and DSSS and DBQ (range from 0.39 to 0.59) provided evidence of validity. This DAX-BR can be preliminary recommended for the assessment of driving anger expression in Brazil among young drivers.

A second study was conducted to provide further validity of the DAX-BR. This second study was focused on a population of drivers on retraining courses to regain the right to drive. They lost it because they previously used to be more aggressive drivers since they had committed many violations and received several traffic fines, mainly speeding, talking on the cell phone while driving and crossing the red light (Detran- PR, 2014). A questionnaire was carried out among 602 drivers aged 21 to 85 years (M = 39.3 years, S.D. = 12.91, 75.3% men). In this study the items of the Adaptive/Constructive Expression factor remained unchanged, as they obtained a good fit in the confirmatory factor analysis. However, the other three factors were redistributed into two new factors: Verbal and Physical and Projective, as no good psychometric parameters were found in the use of the original structure. The Cronbach's alpha of the overall scale was 0.85. Positive correlations were founded between

DAX-BR's factor Adaptive/Constructive Expression and DBQ' scales (Ordinary Violations, r=0.45; Aggressive Violations, r= 0.48).

The idea of this third study was to reduce the impact of aggressiveness on the driver's behaviors and influencing drivers to practice eco-driving (maintaining a constant speed as far as possible, anticipating traffic flow and accelerating and decelerating smoothly). The eco-driving style required should balance with the management of interactions with users and road situations in a safe way (Dogan, Steg & Delhomme, 2011). According to this eco-driving approach, the driver when training tends to avoid heavy braking and sudden accelerations so that he/she can save money (decreasing the fuel consumption), pollute less, and have less aggressive reactions in traffic through anticipation of traffic events. The objective of the third study was to test the effect of training a group of drivers to obtain an eco-driving profile controlling aggressive traffic behaviors. Ten drivers were selected, through volunteering, with each five drivers coming from two different departments from a company that do services of maintenance for the city of Curitiba. All participants were men. The mean age was 34.40 years old (S.D. = 7.90, range = 26 to 50). A before-after design with experimental (eco-driving training) and control groups was used. Each group had five drivers. Before starting the data collection, in both phases of the study (before and after condition) all cars were reviewed for optimal performance (tire pressure, mechanical repairs). Once these conditions were ascertained, participants drove a trial route for five days in the city. Participants of both groups were instructed to keep to the speed limits and obey all of the traffic rules and traffic signs. Once the experimental driving was over participants answered a survey. The experiment began with the training of all drivers. The ten drivers received individual classes for eight hours. For the experimental group the training was focused on the strategies to avoid heavy braking and sudden accelerations, how to make decision in order to avoid traffic flow and was taught the idea to drive on a constant speed. For the control group the training was focused on a safety drive in general. After the experiment, the control group received the same training that was given to the experimental group. A comparative study was made where data from before training (baseline) and those collected after training were compared driving style among drivers. The experimental group reduced the cars fuel consumption in 11.1% and avoided the sudden accelerations and heavy brake behavior. The control group keeps all the same behaviors as they had in the baseline.

To conclude, the use of the DAX scale can be an important resource combined with other instruments such as DBQ, DSSS and the Hostility Scale to measure the aggressive behavior of drivers. According to Benfield, Szlemko and Bell (2007), personality variables such as impulsivity, the sensation seeking and risk taking are linked to aggressive and risk-related behavior such violations and speeding. In conjunction with other strategies, personality variables and emotional state (such as anger and aggressiveness in reaction to a road event) have been considered instrumental in contributing to the implementation of more conscious driving models such as eco-driving that would result in better driving behavior for Brazilian drivers.

Key Words: DAX scale, Car Accidents in Brazil, traffic Aggressiveness, DBQ, DSSS, traffic fines in Brazil, Speeding, eco-driving.

DRIVING ANGER AMONG MOTORISTS ON BRAZILIAN ROADS AND ECO-DRIVING AS A WAY TO REDUCE ANGER.

SHORT ABSTRACT

The objective of this thesis was to study the role of aggressiveness in traffic in Brazil and to examine a strategy to reduce their impact and improve road safety and mobility. The objective of the first study was to validate the Brazilian adaptation (DAX-BR) of the Driving Anger Expression Inventory (DAX, Deffenbacher, Lynch et al., 2002). A total of 512 university students, mean age = 23.8 years (σ = 5.74, 52.1% males) participated in the study. The factorial analysis produced a solution with 43 items in four factors and a global scale with a satisfactory reliability (α = 0.83). The second study focused on the use of DAX-BR for a population of drivers taking courses to regain the right to drive. Participants were 602 drivers, mean age = 39.3 years (σ = 12.91, 75.3% men). It was necessary adjust the factorial solution. The items of one factor remained unchanged and the other three were rearranged in two factors. Cronbach's alpha to the total scale was 0.83. The objective of the third study was to test the effect of training a group of drivers to eco-driving controlling aggressive traffic behaviors. All of them are men with mean age 34.40 years (σ = 7.90). In the experimental group who adopted a smooth driving, fuel consumption reduced more than 10%,whereas no change was observed in the control group. The results indicate that aggressiveness is an important topic to be worked with the Brazilian drivers.

Key-words: DAX-BR, accidents, aggressiveness in traffic, DBQ, DSSS, fines, acceleration, eco-driving.

COLÈRE AU VOLANT CHEZ LES AUTOMOBILISTES SUR LES ROUTES BRÉSILIENNES ET ÉCO-CONDUITE COMME UNE FAÇON DE RÉDUIRE LA COLÉRE.

RESUME

L'objectif de cette thèse de doctorat était d'étudier le rôle de l'agressivité dans la circulation au Brésil et d'examiner une stratégie pour réduire leur impact et améliorer la sécurité routière et la mobilité. L'objectif de la première étude était de valider l'adaptation brésilienne (DAX-BR) de l'inventaire d'expression de la colère au volant (DAX, Deffenbacher, Lynch et al., 2002). 512 étudiant-e-s ayant en moyenne 23,8 ans (σ = 5,74; 52,1% d'hommes) ont participé à l'étude. L'analyse factorielle confirmatoire a fourni une solution en 43 items répartis en quatre facteurs, et l'échelle globale a une fiabilité satisfaisante (α = 0,83). La deuxième étude a porté sur l'utilisation du DAX-BR pour une population de conducteurs prenant des cours pour retrouver le droit de conduire. Les participant-e-s étaient 602 conducteurs, ayant en moyenne 39,3 ans (σ = 12,91; 75,3% d'hommes). Un ajustement factoriel a été nécessaire. Les éléments d'un facteur sont restés inchangés alors que les trois autres ont été réorganisés en deux facteurs. L'alpha de Cronbach de l'échelle globale est de 0,83. L'objectif de la troisième étude était de tester l'effet de la formation d'un groupe de conducteurs à l'éco-conduite en contrôlant les comportements agressifs dans la circulation. Les participants sont tous des hommes qui ont en moyenne 34,40 ans (σ = 7,90). Dans le groupe expérimental qui a adopté une conduite souple, la consommation de carburant a diminué de plus de 10% tandis que dans le groupe témoin, il n'y a pas eu de changement. L'agressivité est un sujet important à travailler pour améliorer le comportement au volant des conducteurs brésiliens.

Mots clés: DAX brésilien, Accidents de la route, Agressivité au volant, DBQ, recherche de sensations au volant, infractions de conduite, vitesse, éco-conduite.

RAIVA NA CONDUÇÃO ENTRE MOTORISTAS NAS ESTRADAS BRASILEIRAS E ECO-CONDUÇÃO COMO UMA FORMA DE REDUZI-LA

RESUMO

O objetivo desta tese foi estudar o papel da agressividade no trânsito no Brasil e examinar uma estratégia para reduzir seu impacto e melhorar a segurança viária e a mobilidade. No primeiro fizemos a adaptação brasileira (DAX-BR) do Inventário de Expressão de Raiva (DAX, Deffenbacher, Lynch, et al., 2002). Participaram do estudo 512 estudantes universitários (52,1% homens) com idade média de 23,8 anos (σ = 5,74). A análise fatorial obteve 43 itens distribuídos em quatro fatores e uma escala com confiabilidade interna total satisfatória (α = 0,83). O segundo estudo foi focado no uso de DAX-BR para uma população de motoristas de curso de reciclagem. Participaram 602 motoristas com idade média de 39,3 anos (σ =12,91, 75,3% homens). Foi necessário um ajuste na solução fatorial sendo que os itens de um fator permaneceram inalterados e os dos outros três fatores foram reagrupados em dois fatores. O alfa de Crombach para a escala total foi de 0,83. O objetivo do terceiro estudo foi testar o efeito do treino de um grupo de condutores para eco-driving controlando comportamentos agressivos no trânsito. Todos homens com idade média de 34,40 anos (σ = 7,90). No grupo experimental, o consumo de combustível reduziu mais de 10%, mas no grupo controle não houve alteração. Os resultados indicam que a agressividade é um tópico importante a ser trabalhado com os motoristas brasileiros.

Palavras-chave: DAX-BR, acidentes, agressividade no trânsito, DBQ, DSSS, multas, aceleração, eco-condução.

To my Family

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To my friends in all their dimensions;

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The company Dataprom.

Dare, dare ... dare everything!!! Do not need anything! Do not try to fit your life into models, or even want to be a model to anyone. Believe: life will give you few gifts.

If you want a life, learn ... to steal it! Dare, dare all! Be in life what you are, whatever happens. Do not defend any principle, but something much more wonderful: something that is in us and that burns like the fire of life!!!

Lou Andreas-Salomé

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1. Introduction

1.1 Traffic accidents

Recent data from the Global Report on the State of Road Safety (WHO, 2015), cite the figure of 1.25 million traffic deaths per year around the world in 2013 with approximately 50 million people surviving with injuries in 178 different countries. Road traffic accidents are the first cause of death in the 15-29 year-old age group. Since 2007, the stability of the occurrence of claims observed, due to actions of traffic safety adopted by national bodies, have been instrumental in saving lives (WHO, 2015).

The problem of traffic mortality is more serious in low and middle-income countries. The WHO (2010) estimates that 90% of deaths occur in developing countries, including Brazil. At the same time, these countries have less than half of the planet's vehicles (47%), which show that driving a vehicle - especially a motorcycle - is much riskier in those places. Looking at the problem, the African continent is the place where accidents leave more victims. In Africa, the mortality rate is 26.6 per 100,000 populations, compared to the 9.3 per 100,000 in Europe and 15.9 in America (WHO, 2015). The most casualties in the world are recorded in Libya, with 73.4 deaths annually per 100,000 inhabitants, and Thailand with 36.2. In Brazil the rate is 23.4 per 100,000 inhabitants, it is similar to rate in Africa continent. Europe is the region of the world where traveling through road is safer. In countries with tougher rules, such as the United Kingdom, Sweden, the Netherlands, and Norway, the annual deaths from traffic accidents are fewer than 4 per 100,000 inhabitants (WHO, 2015). Brazil ranks fifth among record-breaking countries in traffic deaths, it is preceded by India, China, the US and Russia and followed by Iran, Mexico, Indonesia, South Africa and Egypt. Together, these ten nations account for 62% of deaths from traffic accidents (Brasil, 2011).

This PhD Thesis will focus on Brazilian accidents phenomenal, the fifth country in the world in the number of accidents (WHO, 2015). Even Brazil being the depiction of a large economy of the world and having the resources to change it, this problem has been growing in the country (WHO, 2015). Another issue is that the previous Brazilian governmental strategies focused on advertising were unsuccessful (Brasil, 2000).

In addition, the trauma inflicted on the victims and their families, traffic accidents represent high monetary costs for the society (Rozestraten, 2003). Traffic accidents in Brazil are responsible for lost around 1.2% of GDP (WHO, 2015). Based on the methodology previously developed by IPEA (2015) (Institute of Applied Economics Research) the calculations of the costs of traffic accidents in Brazil on federal highways, indicated that approximately 170,000 traffic accidents that occurred on Brazilian federal highways in 2014 generated a cost to society of R$ 3.86 billion dollars. Among them, 64.7% of the costs were associated with the victims of the accident, such as health care and loss of production due to injuries or death, and 34.7% associated with vehicles, such as property damage and loss of loads, in addition to removal procedures (IPEA, 2015). Human factors, such as aggressiveness, are the dominant cause of 90% traffic accidents (Rozestraten, 2003). Therefore, the base of our study is to investigate the effect of aggression on safe driving.

1.2 Central Objective of the PhD

Over the years, several studies have assessed the causes of psychological aspects of traffic events, such as risk perception, attitudes, beliefs and, especially, personality traits (Fernandes, Hatfield & Job, 2010; Hoffmann & González, 2003; Andrade, Soares, Braga, Moreira & Botelho, 2003; Montoro, Alonso, Esteban & Toledo, 2000; Marin & Summala, 1996; Rajalin, 1994). In addition, over the last decade, many international studies have established a relationship between personality traits and risky traffic behavior, and some of these traits stand out. For instance, set of traces called anger presented a predictive relation with risk behaviors such as 'exceed speed limits' and 'violations', in addition to the historical of infractions and traffic accidents (Sümer, 2003; Ulleberg & Rundmo, 2003; Dahlen, Martin, Ragan, & Kuhlman, 2005; Dahlen & White, 2006; Machin & Sankey, 2008; Fernandes et al., 2010). Aggressiveness and Impulsivity also appeared as strong predictors for risk behaviors, especially between young males (Sümer, 2003; Ulleberg & Rundmo, 2003; Machin & Sankey, 2008).

In Brazil, aggressiveness in traffic is a big issue and could be an important contributing factor for the high rate of traffic accidents (Cuffa, 2016). According to Marín-Léon and Vizzotto (2003) the main aggressive problems recorded among Brazilian drivers are related to speed (20%), fighting in traffic (8%), crossing the red light (15%), drunk driving (30%) and prohibited overtaking (20%). As previously shown, the number of accidents and the financial cost resulting from them is a problem for the Brazilian government with the results much more devastating than war (Brasil, 2011). However, the country has striven to reduce accidents and avoid the aggressiveness of drivers in traffic through measures such as mass campaigns, modifying and creating stringent traffic laws and offering traffic education programs to population (Brasil, 2010).

The increase in the number of traffic accidents in Brazil shows that is needed to conduct studies in an effort to mitigate the risks involved in their occurrence.

Aggressive behavior and anger are not always tied to a person's personality; they can also occur due to the emotional state of a moment or in reaction to a fact (Silva, 2008). Aggression has been cited as one of the major contributors to traffic accidents. In other countries (Villieux & Delhomme, 2010; Sârbescu, 2012; Sullman, Stephens and Yong, 2015) the level of aggression amongst drivers has successfully been measurable by the use of the Driving Anger Expression Inventory (DAX) (Deffenbacher et al., 2002) that will be replicated in the study. The study adopted the DAX scale to the Brazilian context and the correlations between the Sensation Seeking Scale and Hostility Scale, as in the case of Delhomme, Chaurand and Paran (2012). The tools provide a greater understanding of the occurrence of aggressiveness behaviors amongst the drivers.

To summarize, the overall goal of the thesis is to study aggressiveness in driving in Brazil and contribute with different approaches to the issue of aggressiveness and to a better understanding of drivers' behavior in different contexts. The focus will be on individual factors, and their sources of influence from both the social and environmental context and their interactions, which in addition to external factors could affect driving behavior. Therefore, the central objective of this PhD thesis is to study the role of aggressiveness in road traffic in Brazil and to examine how by improving eco-driving is possible to reduce aggressiveness and improve road safety and mobility.

1.3 Research Approach

Evaluations strategies used to investigate aggression while driving according to Dahlen and White (2006) range from psychological tests such as projective techniques and objective scales to psychiatric techniques or interviews (Machin & Sankey, 2008). The use of instruments should be specific in regards to reliability and validity (Storry, 2017). When properly used, standardized and appropriate instruments can provide useful information about an individual's personal characteristics (Cantini, Santos, Machado, Nardi & Silva, 2015).

Crash records can produce equivocal results (Fernandes, Hatfield & Job, 2010). For Jovanovic, Lipovac, Stanojevic and Stanojevic (2011), based on personality or specific social traits, most of these findings are not validated because of methodological problems as inadequate control of variation of exposure and level of danger, small sizes of samples, use of tests and failure to validate findings with different populations (Jovanovic et al., 2011). Then, due to methodological problems, these results should be treated with caution.

Fatalities that result from motor vehicle accidents are rarely certified as suicides (Brasil, 2011). But evidence suggests that probably less than five percent of all deaths per vehicle are suicide results (Pelsmacker & Janssens, 2007). In addition, in a study about it, although the characteristics of suicides and those involved in fatal accidents were considerably more deviant than the general population, the greatest deviation was founded in the suicide sample than in the accident sample (Pelsmacker & Janssens, 2007).

Propensity to accidents has been attributed to personal factors that result in the occurrence of accidents. It makes sense, because as noted by Sullman et al. (2015), reports of intentional acts of violence or malicious damage on the road with road drivers are rare, although they occur. To Jovanovic et al. (2011) the concept of a propensity to accidents has a great influence in the study of the personality factors of the drivers involved in accidents. This propensity refers to one or more traits of personality or types (Cuffa, 2016).

Drivers with a high accident risk have a wide variety of common features. Some demographic features are associated with a greater risk of involvement in an accident (Constantinou, Panayiotou, Konstantinou, Loutsiou-Ladd, & Kapardis, 2011). These features include drivers whose age is less than 25 years, lower training and schooling less than twelve years (Bartholomeu, 2008). Within this population has high-risk drivers are a number of subgroups that include drivers that driving under the influence of alcohol, young male drivers and possibly the mentally ill (Bacchieri & Barros, 2011).

According to Cannell (2001), driving aggression and personality traits contribute immensely to the number of accidents resulting to an increase in causality. To Bachoo, Bhagwanjee and Govender (2013), the personal factors associated with vehicle accidents were generally high levels of aggressiveness and hostility, competitiveness, little concern for others, driving for emotional release, impulsiveness, and attitudes to take on. In the context of social disruption and diversion, it seems more common to find fault and/or violation of drivers involved in accidents (Silva, 2008).The potential value of research into the personality and social characteristics of the driver problem lies in establishing effective means to predict with reliability an accident (Bachoo et al., 2013; Sullman et al., 2015). However, if there is any consistency in these characteristics, there doesn´t appear to be a single test or battery test in which individual accident liability can be predicted (Lucidi, Giannini, Sgalla, Mallia, Devoto & Reichmann, 2014; Silva, 2008). The precise identification of the casualties is problematic to the concerned authorities. In addition, Cheng, Ng and Lee (2012) noted that prohibit these individuals from driving has few effects in total system, since them can be considered as constituting only a small proportion of the motorists' population (Pelsmacker & Janssens, 2007). Moreover, in general, the composition of groups that have suffered accidents is not constant from year to year (Cannell, 2001).

1.4 Aggression: origin and definitions

According to Bacchieri and Barros (2011) there are a great number of different ideas about aggression, none of them considered a complete explanation, because they reflect on the orientation and requirements of the researchers who developed them (Bhalla, Sarre, Redlich, Tinker, Sadler & McKevitt 2014).

Biological theories consider that behavior as something innate, although specific responses would be modified by experience (Bartholomeu, 2008). For the traditional psychoanalytic analysis, the frustration-aggression hypothesis proposes that the origin of aggressiveness is in the behaviors that must find in external factors (Hoffmann & González, 2003). There is a social learning theory in which aggression is a response through the observation or imitation of other socially relevant people (Bacchieri & Barros, 2011). Aggression according to Winnicott (2000) is the result and addition of the social norms, rewards, punishments; stating that aggressiveness is the motility of the human being and that an aggressive act is influenced by the external environment in which an individual is exposed (Fadiman, 2017).

Lajunen (2001) points out that the variables of human behavior tend to differ in the emphasis that they get assign to the role (genetic and evolutionary inheritance) processes and experience (learning through exposure to environmental factors), aggressive behavior is the result of the interaction of these factors.

According to Fadiman (2017) the definition of aggressive driving can be as any behavior directed at causing physical or mental injury. The concept of intention is useful in discriminating between intentional acts, where intent was to cause harm to others, and acts of a coincidence, that reveals a will, with dangerous results, in order to satisfy the motives of the driver (Fadiman, 2017; Iversen & Rundmo, 2002). The latter situation necessarily involves behaviors in which the driver does not intend to harm other road users and may not be aware of what risks are involved (Bartholomeu, 2008). This driving behavior is aggressive in appearance but does not necessarily imply intent to cause damage, although it may subsequently put other road users at risk (Vallieres, Bergeron & Vallerand, 2005).

According to González-Iglesias, Gómez-Fraguela and Luengo-Martín (2012), road user behavior of which aggression is an aspect, should be considered within the social and psychological context in which it occurs. In this, road user behavior is considered to reflect a balance of motives (e.g. the desire for speeding or get a better position in the traffic flow) and subjective risk of involvement in a collision. According to Naatanen and Summala (1974, 1976), the central point is the fact that drivers generally do not perceive any risk of being involved in an accident. This absence of risk perception of involvement in accidents allows drivers to attend other varieties of needs such as saving time (Naatanen & Summala, 1974, 1976).

Introduction

The concept of risk perception has different implications for driver risk, one of them as in the Risk Homeostasis theory (Wilde, 1982, 1994). According to the concept of risk homeostasis, road users have a constant level of risk that they are prepared to accept if they have the perception of safety. This theory assumes that the driver is aware and desires the level of risk that he or she is taking (González-Iglesias et al., 2012).

Other factors may also influence aggressive or risky behavior such as stress and alcohol (Oliveira, 2008). Research focused on the evaluation of personality variables, measured by tests, to predict aggressive driving behaviors (Deffenbacher, Lynch et al., 2002; Villieux & Delhomme, 2010; Dahlen et al., 2005). They have strived to explain the relationship between aggressive driving and traffic accidents (Féris, 2003; Heckman, Stixrud & Urzua, 2006). Silva (2008) explained that aggressive driving may relate more to the members of the "normal" driving than the deviant driver who may be unable or unwilling to control their aggression.

Researchers such as Naatanen & Summala (1976) have suggested that frustration may explain the occurrence of aggressive behavior in some instances. According to Gold, (2003), the frustration-aggression hypothesis proposes that individuals need to discharge feelings of frustration. An individual who has not taught proper ways to deal with frustration or anguish may enter into futile conduct and attempt to take control (Yamada, 2005). Given the often-frustrating nature of driving, it may not be surprising that some drivers are aggressive in response to the difficult situations they face every day (Naatanen & Summala, 1976; Silva, 2006; Yamada, 2005). The contribution of aggression in the road accidents was 0.6 percent as frustration or aggression and 1.6 percent as reckless driving (Jovanovic et al., 2011).

Another possible explanation for aggressive behavior is that the car essentially isolates the driver from other road users. In addition, the design of the automobile offers a certain amount of immunity from retaliatory action (Moeller, Barratt, Dougherty, Schmitz & Swann, 2001). Therefore, the vehicle owners feel less restrained in revealing aggressive dispositions. In otherwise, where aggression is used in the defense of the home, if the number of car owners increases, aggression may occur "to promote the driver's sense of property rights" (Gosling, Rentfrow & Swann, 2003 p. 20). To the young male driver, who, in general, has little real estate, the motor vehicle becomes a symbol of power and prestige, a part of its territory to be defending aggressive exposures that threatened or violate her or him integrity.

As observed by Gold (2003), aggression in human beings is shaped by social norms and values. It may be that social values influence attitudes toward aggressive driving and behavior (Yamada, 2005). Learning can also influence the situations and means by which feelings of frustration and aggression are expressed (Lamounier & Rueda, 2005). However, all of these observations must remain speculative on conclusive evidence. The bases of conclusive aggressiveness are highly complex and probably occur because of a combination of biological, social, and behavioral factors (Coie & Dodge, 2000).

Therefore, integrating the biological, social and behavioral factors in this perspective implies being able to explore the subjective position of drivers, with their personal assessments, their personality (Cuffa 2016). Also, implies to explore the driver's psychological motivations and their psychological barriers and behaviors to reduce the impact of aggressiveness and ensure sustainable eco-driving (Jacobi, 2003). Due to its green, social and sustainable features, the eco-driving way of driving can lead the drivers to one answers to improve current, traffic problems (drive aggressively) (Ueba, Ledesma & Montes, 2010). Furthermore, Fernandez (2013) suggested that anchoring motivate new behaviors that encourage safe driving and calmness.

According to Monteiro and Günther (2006), conducting a more in-depth understanding of the context in which aggressive driving occurs is necessary. Possible strategies for dealing with aggressive driving include controlling the drivers and modifying the behavior of the driver (De Young, 2010; 2014). But, as observed by Nunes, Chapman and Crundall (2010), any initiative to try to deal with driving aggression must necessarily take into account the theoretical approach adopted. There can be little doubt that there is a learning component (at least in the forms and situations in which aggression is expressed) on aggressive behavior (Gold, 2003). And, about it, the society as a whole determines the level of safety margins and its learning. Taking risk and competitiveness can be considered, in part, to be encouraged by society (Nunes et al., 2010; Costa & McCrae, 2007).

As recommended by Gold (2003), the damage brought about by aggression on the roads can be limited by emphasizing an eco-driving culture that encourages drivers to adopt more settled and reasonable reactions while on the road. Stress reduction among drivers can also go a long way in ensuring the drivers are willing and adhere to the stipulated laws and regulations (Cuffa, 2016).

1.5 Eco-driving

Eco-driving style offers numerous benefits; it not only saves fuel and costs but also improves safety as well as local and global environmental quality (Kurani, McCarthy & Yang 2010). According to a large study by Fiat (which included 5,700 drivers in five countries), eco-driving saves an average of 15% of fuel costs (Mannering, 2009). Considering the average mileage of cars of 12,285 km/year, the average specific consumption of cars of 7.3 liters/100 km and the average fuel cost of 1, 43 euros per liter, this corresponds to a reduction in annual savings of 192.5 euros, for the driver. Eco-driving reduces not only fuel costs, but also, the vehicle maintenance costs and car repair costs. Eco-drivers cause less depreciation of auto parts (tires, brakes and motors) and are less prone to accidents (Wahlberg, 2007).

The safest driving behavior can be cited one that the driver anticipates the traffic events, which means less acceleration and braking, less speeding and overtaking, and a less stressful and aggressive driving impact in general (Stillwater, 2011; Pelsmacker & Janssens, 2007). It is eco-driving. Furthermore, eco-driving ensures the driver is more relaxed while driving and has a number of health benefits for drivers and overly improves driver satisfaction (Kurani & Stillwater, 2011). According to a study that investigated eco-driving training at the Hamburg Water Company, car accident costs decreased 40% following the training. Eco-driving this is mainly achieved through drivers keeping a greater distance from the car ahead (Pelsmacker & Janssens, 2007).

For Jacobi (2003), drivers practicing eco-driving do not take longer to reach their destination, but are often even faster. This is mainly due to speed up traffic flow and thus avoiding stops (Kurani & Stillwater, 2011). Eco-driving is also environmentally friendly (Kahneman, 2011) because driving style has an impact on the noise that motor vehicles generate and in the fuel consume, and in a world where, temperatures are rising and experts say the environment is under threat from toxic emissions caused by carbon dioxide (CO2) (Jacobi, 2003), it is a hopeful strategy.

One way to reduce emissions is by driving in a more environmentally friendly way and by improving fuel consumption so that less fuel used to travel the same distance (Stillwater, 2011). Consequently, measures to improve driving behavior promote fuel economy and consequently reduced CO2 emissions from traffic. Therefore, if eco-driving becomes the norm rather than the exception, it has the potential to reduce emissions from motorized road transport (Birrell & Fowkes, 2014).

1.6 Overview of the PhD Thesis

In addition to the introduction and the general discussion, this thesis is composed of two main parts: the theoretical aspects and the empirical research. The theoretical aspects (Part I) comprise three chapters which gives an overview of the research program.

The chapter, called “Driving Activity and Behavior”, is an overview of the understanding of the phenomenal of driving activity and how driving is a multifactorial task, describing the behaviors, the traffic environment and the cognitive aspects of attention as well as the behaviors adaptation. The other chapter is focused on personality factors and emotional states that are positively linked to speeding. It contains two sections. The first section focuses on the driving anger, and the second one on the sensation seeking. The last chapter concerns the overview of the research program, including the research questions and the main hypotheses. This chapter makes the connection between the theories presented in the previous chapter and the next main part containing the empirical studies.

The empirical research (Part II) is composed of three chapters presenting each one of three studies carried out in this work. The first two studies were focused on the adaptation of Portuguese of DAX scale into Brazilian context. We have examined the links with traffic accidents and violations as well as with sensation seeking and hostility while driving. These studies were conducted among two different populations: the first study was conducted through an undergraduate student sample, whereas the second one was conducted among drivers who lost the driving license because fines and are attending a recycling driving course to retrieve it. Then, the third study focuses on professional drivers from a company in Curitiba testing a training course in eco-driving as a means to reduce aggressive driving.

Finally, in the general discussion and conclusion, the results of these three studies concerning the behaviors and personality aspects and the theoretical and societal implications are discussed, as well as the limits of the studies and the perspectives for future research.

PART I: THEORETICAL ASPECTS

2. Driving activity and behavior

2.1 Driving activity

2.1.1 Models

Although driving is a common activity in the world today, driving often involves a complex process which is characterized by the interaction between both psychological and cognitive function (Michon, 1985; Rodriguez, 2009). Michon (1985) also represents driving as a dynamic task that requires information to enhance proper and timely decision-making. Drivers are expected to make conscious choices based on the specific driving situation (Sampaio, 2012). While the actions of many drivers are often influenced by past experiences, the act of driving often involves an ever-changing set of tasks (Rodriguez, 2009; Sampaio, 2012).

Michon (1985) identifies 3 major levels of task processes involved in driving; the strategical level (planning), the tactical level (maneuvering) and the operational level (control). The strategic level is characterized by high level reasoning and planning; it is synonymous with having a general plan of driving (Salvucci, 2006). This may involve making decisions such as select a route and speed to drive (Michon, 1985). The maneuvering level is also known as the tactical level and it involves the driver negotiating through the prevailing conditions of the driving. This could include tasks such as turning, overtaking and avoiding obstacles on the road (Michon, 1985). Salvucci (2006) also notes that the tactical level involves making decisions that ensure safe interactions with the driver's environment (including other vehicles and road users). Thirdly, there is the operational level also known as the control level. This involves the control inputs that are meant to facilitate stable driving

(Salvucci, 2006). Driving often involves all three of these task levels working together to ensure safer driving decisions and ultimately, better driving experiences. These tasks can therefore take place at any time or moment during the driving process.

Drivers are often exposed to a number of risk factors when in traffic (Pasa, 2013). Driving a vehicle involves memory, attention and decision-making in an environment full of information such as: pedestrian traffic, other vehicles, diversity of sounds and images (Pasa, 2013). The combination of them is what makes driving a difficult task. These factors also play a major role in influencing the behavior of drivers and ultimately, the driving experience (Pirito, 1999). More specifically, the interaction of all these factors within the driving environment has a significant influence on the technical, preventive, and defensive decisions of the driver (Pirito, 1999; Balbinota, Zarob, & Timm, 2011).

2.1.2 Driving Environment

Romano, Peck, and Voas (2012) reasoned that there is a common consensus that even when driving, drivers are always in interaction with the environment. The nature of this interaction has a major influence on the decisions that the driver chooses to make. The driving environment is quite expensive and often involves multiple factors all of which have different influences on the driver’s decision-making and ultimate driving experience. Studies have examined the driving environment and its effect on the driver and the driver’s decision-making (Pirito, 1999; Günter, 2003; Balbinot, et al., 2011). Hennessy, Wiesenthal and Kohn (2000), identify traffic jams as a major component of the environment. Both high and low congestion traffic jams are linked with increased drivers stress due to their effects on time urgency (Hennessy, Wiesenthal and Kohn, 2000). Drivers with high stress levels have been found to report more incidences of bad driving decisions such as speeding violations and causing minor accidents (Hennessy, Wiesenthal & Kohn, 2000).

Aside from traffic jams, the driving environment also includes factors such as the design of the road. For example, drivers are likely to approach a sharp corner at a slower speed than one that has a larger radius. However, it is important to note that the drivers often underestimate the sharpness of corners subsequently leading to inappropriately high speeds while navigating the corner (Edquist, Rudin-Brown, & Lenne, 2009). For Rozestraten (2003), it has also been established that a road that is too wide or too narrow may increase the risk of various types of road accidents. There are many other elements within the driving environment including objects next to the road (such as vegetation, walls, railings, etc.), visual clutter in the roadside environment, day time (night vs. day), other road users and weather conditions among others (Edquist, Rudin-Brown, & Lenne, 2009).

2.2 Psychological Functions

Aside from the driving environment, there is widespread consensus that traffic safety also depends on a number of drivers specific psychological factors as the cognitive aspects (memory, attention and others) and personality, both of them interact and influence together (Buchi,Sangiorgi & Vignali, 2012).

Personality is the set of consistent psychological characteristics of each person that determine the personal and social individuality, that is, it is a unique and specific set of stability psychological characteristics (pattern of thoughts, feelings, behaviors) of a person over time (Buchi et al., 2012). This stability exists even when compared to attitudes and transient factors such as emotional state or fatigue (Winnicott, 2000; Allport, 1954) defining personality as the dynamic organization, of psychophysical systems, that determines a way of thinking and acting. This organization is unique in each subject in its process of adaptation to the environment (Buchi et al., 2012). The dynamic aspect of the personality is reflected in the fact that each person is constantly interacting with the environment, which is only interrupted by death. Regarding the ways of thinking and acting, these show that the personality has an inner strand (the thought) and an external strand (the behavior) (Allport, 1954).

Personality is constructed through three main processes: perception, learning and memory (Buchi et al., 2012). Perception is the observation of reality through the individual's senses, realistic theory proposes that the brain grasps reality exactly as it appears and representative theory, suggests that the brain determines reality through its own interpretations (Buchi et al., 2012). After a general fact had it perception, it´s necessary to change the level and learning with it.

Learning is the process through which an individual adopts certain behaviors. Learning arises from the processes of observation, exploration and also experimentation (Buchi et al., 2012). Learning may take place through experience or through the acquisition of ideas. In driving, learning through experience is perhaps the most important type of learning and it is also a huge determinant of behavior changes in the driver (Buchi et al., 2012). Through driving, individuals learn a range of driving behavior and it is therefore possible for drivers to learn safe driving behavior simply from experience. However, this is not always the case.

Memories are the consequence of the experiences of approximately 87 billion neurons, they communicate with each other through a chemical process that is named synapse, creating an infinity quantity of combinations (Dalgalarrondo, 2005). When an individual learns, he creates new brain connections, which actually occurs by the combinations that occur in neurons (Silva, 2011). Every time a person experiences something new, or assimilates a new fact, this person goes through an imbalance, which has as a consequence the modification and creation of new brain circuits. This modification in the activity of the nerve circuits results in what we call memory (Dalgalarrondo, 2005; Silva, 2011).

These configurations with these new connections can be combined between the neurons to form new neural circuits, the final number of these neural circuits is very high, bordering infinity, so the construction of a complex structure that keeps the memories and creates the mental processes, as named personality (Nunes & Hutz, 2002). To Buchi et al. (2012) it must be noted that memory in this case does not only refer to the storing of information but rather, includes the ability to use the stored information adequately in the future. The memory allows the driver to correctly perceive the road and the driving environment; this information is often stored unconsciously (Buchi et al., 2012).

Drivers are left with the challenge of paying close attention to their surroundings and correctly perceiving these surroundings. Further, drivers must be able to correctly evaluate and interpret the surroundings so as to make the most viable driving decisions (Primi, Muniz, & Nunes, 2009). Most importantly, however, drivers must be able to take accurate decisions quickly; in some cases, within a split second (Hoffmann & Gonzales, 2003).

Psychological factors, inherent within the driver, are always in interaction with the specific prevailing environment of the driver. This means that the mental load of performing certain driving tasks is different for different individuals (Gosling, Rentfrow & Swann, 2004). For example, a busy highway may make a driver more anxious than other drivers. This may in turn lead to the driver engaging in fearful behavior and inappropriate driving decisions (Clapp, Olsen, Danoff-Burg, Hagewood, Hickling, Hwang, & Beck, 2011).

The act of driving often requires the interaction of multiple cognitive functions of the driver. Cognitive functions refer to tasks such as judgment, reasoning, memory retention, attention, recognition and even language (Horikawa, Morizono, Akemi, & Horie, 2009). These functions are considered essential for day-to-day activities and are therefore indispensable when it comes to driving. Cognitive functions are important in ensuring that drivers properly recognize and identify elements of the driving environment such as traffic signs, roadside obstacles, distances and even curvatures on the road (Hoffmann & Gonzales, 2003; Rozestraten, 2003). To the traffic psychology the attention and memory task are very important topics, because those points are strongly related to accidents (Hoffmann & Gonzales, 2003).

Research has also established that fatigue has a major impact on cognitive functions (Delhomme & Simoes, 2017). Fatigue can be described as a state of exhaustion that the body requires rest. Fatigue is known to have a reducing effect on the alertness (attention) of drivers and ultimately, their driving experience and behavior (Gosling et al., 2004). Fatigued drivers may become more impatient and, ultimately, may even go into a state of sleepiness or involuntary sleep. Further, Delhomme and Simoes (2017) suggest that fatigue in drivers is closely linked with increased irritability, impatience and even increased stress. All of these factors have an effect of increasing the likelihood of cognitive function loss. Thus, fatigue and drowsiness are linked to deterioration in performance and an increased risk of accidents (Knutsson, 2004).

2.2.1 Attention

Studies suggest that attention is one of the most important cognitive functions in driving and particularly in the operational and tactical task levels (Lundqvist, 2001; Hoffmann & Gonzales, 2003; Rozestraten, 2003). This is because attention is a prerequisite for information processing. Attention allows the driver to pick out from the driving environment, the relevant information required to achieve driving goals and objectives (Lundqvist, 2001). Attention therefore allows individuals to filter out information that is irrelevant for their goals. It has a direct impact on the memory, the reason attention is important for operational and tactical task levels, because the attention will select with information will be used to take the decisions in the operational and tactical level.

According to Sternberg (2000) attention can be understood as cognitive in which there is the concentration of the psychic activity in a specific stimulus, be it a sensation, a perception, a representation, an affection or desire, in order to elaborate concepts and reasoning. In Rozestraten's (1988) analysis of traffic accidents, the main deficiencies in the driver's action were the lack of attention (23%) 12.7% of them looked very fast, 36.6% looked, but failed to observe, 12% occurred distraction, 8.5% had inexperience, 7.4%; lack of observation.

Perception is a process related to attention, and often these are confused (Marín-León & Vizzoto, 2003). The process of interpreting, selecting, and organizing information obtained from the senses refer to attention (Harré, 2000). According to Gesser (2014), attention and awareness are activated when the brain is confronted with events or problems that it deems important and new. With the help of various types of memory, the brain classifies perceptions according to their importance, if more or less known. Information that is important and known activates processes already experienced in the past. In this way, the brain can perform routine functions with a minimal level of consciousness (Gesser, 2014; Harré, 2000).

Experiencing different situations and learning from the different demands of the prevailing conditions are an important factor in the determining decisions and choices that drivers make while in traffic (Balbinot, et al., 2011). For Roma (2015) attention is a fundamental psychic process in traffic, especially for the driver, when driving, because he is in an environment with many stimuli such as pedestrians, cyclists, signs and various sounds. The ability to sieve through the different stimuli and only focus on that which is necessary for driving is a sign of alertness. Alertness also helps in the avoidance of danger while on the road.

Drivers are constantly and continuously receiving different information from the driving environment. They must be able to concentrate on driving and at the same time, be attentive enough to take in other information from the environment without taking the main attention out of the driving act (Neves & Pasquali, 2007). Attention reduces the likelihood of drivers making wrong decisions and wrong maneuvers due to misinterpretation of information (Gosling et al., 2004).

There are two types of attention based on the nature/origin of the attention; voluntary and involuntary (Dalgalarrondo, 2000; Macar, 2001). Voluntary attention involves the active and deliberate selection of what to concentrate on. Voluntary attention is directly linked to motivations, interests and expectations. For example, it is common knowledge that one of the biggest challenges modern driving faces is the growing popularity and importance of smart phones and the internet. This is because people; especially young people, are always using these technologies, even when driving (Balbinot et al., 2011). Subsequently, this leads to a greater propensity to make mistakes when driving due to the loss of attention. Conversely, involuntary attention is often triggered by other stimuli in the environment; it tends to be more passive and also occurs unconsciously in most cases (Dalgalarrondo, 2000; Macar, 2001). For example, a sudden bang may get the immediate attention of the driver, momentarily distracting him/her from the actual act of driving and subsequently increasing the risk of bad driving decisions (Macar, 2001; Neves & Pasquali, 2007).

A driver while driving in his or her routine may reduce selective attention and self distract with thoughts or concerns in his or her selective cognition (Simon & Corbett, 1996). It can be seen from the fact that sometimes a certain part of the path was not noticed when it was traveled, because the driver's attention was not focused on the path (Gazzaniga, Ivry, & Mangun, 1998). The brain captures and processes a lot of information; some of it unconsciously and some of it consciously. Initially, controlled, conscious and automatic processes perform the execution of many tasks including driving (Gullone & Moore, 2000; Hilakivi et al., 1989; Ulleberg, 2002; Ulleberg & Rundmo, 2001).

Many tasks, especially those requiring practice, need to be consciously perceived first (Gazzaniga, et al., 1998). In traffic jams for example, it is quite easy for drivers to get distracted and lose their attention from the actual act of driving. Perceiving movements and objects is important in avoiding accidents as well as perceptual field scanning (Huang et al., 2007).

Sternberg (2000) evaluates the execution of many tasks and observes that the conscious and controlled processes, which later become automatic, initially perform daily and repetitive tasks. For example, the action of driving a car, over time and practice, is no longer controlled and becomes automatic, without the awareness of all movements, an experienced driver is still able to control the car and at the same time, pay attention to the driving (Sternberg, 2000).

2.3 Behaviour

Many studies have recognized the important of psychology in the study and evaluation of driving behavior among individuals (Fariz et al., 2005; Barros & Silva, 2006). The recognition that individual behavior and psychology play a role in traffic and transport has led to the emergence of what is now known as traffic psychology (Buchi et al., 2012). Subsequently, traffic psychology is defined as an area of study that focuses on understanding the behaviors of people in transit as well as external and internal human factors, conscious or not, that can provoke or change these behaviors (Buchi et al., 2012). Indeed several studies have established that certain behaviors of individuals can contribute to the occurrence of certain accidents (Rozestraten, 1988).

Günther (2003) distinguishes three dimensions to predict behavior in traffic: Degree of knowledge - knowledge of traffic rules and certain laws of physics; Practical - ability acquired over time; and Attitudes - readiness or willingness to use knowledge and practice for the benefit of behavior in traffic that prioritizes not to endanger or harm others (Günter, 2003). All of these dimensions will contribute to the decision-making process.

2.3.1 Decision-making

Khisty and Lall (2003) assert that all through the driving process, drivers are exposed to different circumstances and scenarios all of which demand for certain forms of decision-making to take place. For example, when faced with an obstacle on the road, the driver is expected to make a decision that ensures he/she avoids the obstacle successfully. The ability to make appropriate decisions is of absolute importance to driving. Indeed, as noted earlier, at any one single time, drivers are often required to make numerous decisions in driving task processes (Cupolillo, 2006). Drivers regularly make decisions slow down, speed up, overtake and shift gears among other decisions.

According to Khisty and Lall (2003), the decision-making process involves perception and attention, using both of them an individual extracts necessary information from the environment as input to their decision-making (Souza, Reis, Minayo, Santana & Malaquias., 2002). Thus, it is useful to evaluate the time required from perception to the reaction. The perception would then involve the delay in perception (time between visibility and point of perception) and the interval of risk identification (time to know that there is a possibility of accident) (Souza et al., 2002). Thus, the reaction would comprise the time component for analysis and decision-making, plus effective response time, for example, putting the foot on the brake (Souza, 2001), for e.g. according to Azeredo (2007), one of the most frequent collisions in traffic is the rear one, due to the error in the process of reaction. If the front driver reduces the speed of his/her vehicle, the rear driver must do the same to avoid collisions (Correia, 2000). The collisions could happen in case due to three main things; lack of attention, incompatible speed and not maintaining a safe distance from the car in front. A tolerant environment can absorb some unsafe acts, including intentional acts, but a high tolerance can also give result in drivers assuming and ignoring the risk associated with a certain behavior (Wilde, 2005). Contributing to the complexity of the situation it is important to consider that could have some additional facts in the behavioral adaptation.

2.3.2 Behavioral adaptation

Hollnagel, Woods and Leveson (2006) note that driving often takes place in a complex system and in the presence of pressures and conditions that are continuously changing (Correia, 2000). These ever-changing environment requires drivers to be effective in behavior adaptation. It is any change in driver behavior, which occurs following its interaction with a change in the traffic system i.e. in the driving environment (Kulmala & Rama, 2013). Drivers who have experienced situations requiring them to pursue behavioral adaptions are more likely to be willing to facilitate behavior adaptation when faced with new challenges and conditions (Bjernskau, 2013).

This is the case of the extension of lanes on highways which results in an increase in the average speed at which people drive. Similarly, drivers who wear protective equipment or whose cars are fitted with certain protective equipment that can reduce the consequences of a collision, also tend to adapt behaviors to more risk such as over-speeding (Souza, 2001).

According to Wilde (2005), technological or environmental actions that result in changes in the level of risk sought should be accompanied by other measures, such as the dissemination of relevant information and the promotion of communication campaigns on road safety. Given the extreme diversity of skills and behaviors in road transport as well as the prevalence of non-compliance with set rules and regulations there needs to be more awareness campaigns regarding the importance of safety measures and safe driving (Delhomme & Simoes, 2017).

2.4 Risky Behaviour

It is a well-known fact that one of the biggest killers in the world is traffic accidents. In fact, it is estimated that at least 1.2 million people lose their lives annually in accidents while up to 50 million more suffer from a range of injuries (WHO, 2013). A significant number of these accidents have been as a result of the driver engaging in certain types of risk behavior either consciously or unconsciously. Risk behavior is best defined as behavior that greatly increases the risk of an accident or the risk of injury from an accident. Risk behavior often varies between different individuals as well as between different conditions of one individual (Oprea, 2012).

Two theories of social psychology are important in understanding risk behavior when driving; the theory of Reasoned Action and the theory of Planned Behavior (Ajzen, 1991; Ajzen & Madden, 1986). Although not specifically developed for applications in the traffic field, these two theories have often been used to understand human behavior in traffic. These theories suggest that changes in the attitudes of young people in relation to driving has been shown to be an effective way of predicting risk management and involvement in accidents. Studies demonstrate a correlation between attitudes, exposure to risk behavior involvement when in traffic and increased risk of accidents (Ulleberg & Rundmo, 2002; West & Hall, 1997). These theories have proven to be effective and comprehensive in considering the importance of attitudes and the influence of social factors in the prediction of behavior in traffic (Arnett, 1990; Arnett, Offer, & Fine, 1997; Donovan, et al., 1985; Jonah, 1997; Jonah, Thiessen, & Au-Yeung, 2001; Trimpop & Kirkcaldy, 1997).

The use of cell phones while driving, drinking while driving and even having an argument while driving are all good examples of risk behavior. A huge amount of research has attempted to understand the increasing prevalence of risk behavior among modern day drivers (Ferreira, et al., 2009; Constantinou et al., 2011; Cuffa, 2016). The quality of the parent-adolescent relationship also has an impact on the development or prevention of teenagers in risky driving (Smorti & Guarnieri, 2014). The family, and in particular the relationship between adolescents and their parents, is one of the most import examples (Bianchi & Summala, 2002).

Personality is also seen as an important determinant of risk behavior when driving (Constantinou, Panayiotou, Konstantinou, Loutsiou-Ladd, & Kapardis, 2011). For example, close links have been established between extraversion and an increased likelihood of engaging in risk behavior, and individuals with high levels of self-control are less likely to engage in risk behavior (Ferreira, Martínez, & Guisande, 2009). It is particularly interesting to note that many drivers view their cars as extensions of their personalities; it is therefore quite common to hear of people using their cars to express themselves especially in relation to other drivers (Ferreira et al., 2009). For Sarbesc, Stanojevic and Jovanovic, 2014 (2014) many drivers, and especially younger drivers, associate driving with power; they use their cars to pursue their own hedonistic pleasures and to reflect their own realities (Rivis, Abraham, & Snook, 2011; Scott-Parker, Watson, & King, 2009).

Oprea (2012) identifies several factors that could result in risk behavior. These include factors such as the quality and the design of the road, driver's emotional state while driving, time of day, weather conditions and even factors such as age, driving experience, gender and lifestyle (Oprea, 2012).

Self-reporting methodology has been used to examine gender and lifestyle differences in driving behavior and revealed that men are more risk drivers than women. Men tended to engage in more risk behavior than women (Parker, et al., 1998), and were more likely to be associated with traffic violations and to drive more aggressively (Ferreira, Martínez & Guisande., 2009; Parker, et al., 1998). Finally, male drivers were more prone to drinking and driving and tend to make more impulsive decisions and engage in more sensation seeking behaviors (Jonah, 1997).

2.5 Speeding

One of the risk behaviors is speeding. Speeding behavior is without doubt one of the most common and voluntary risky driving behaviors among drivers all around the world (Haglund & Aberg, 2000; Simons-Morton, Ouimet, Chen, Klauer, Lee & Wang, 2012) and it is associated with social acceptance, especially when speed is not excessive (Soole, Watson & Fleiter, 2013). In response to this social acceptance and to driver aspiration, the automobile industry develops increasingly powerful and fast vehicles (Cupolillo, 2006). It argues, for example, that because of technological advancements, vehicles and highways are increasingly safe and therefore, the speeds practiced may be higher. Such arguments fail to take into consideration other factors such as weather conditions, smoke and time that affect speed, performance of the vehicle and also performance of drivers (Cupolillo, 2006).

However, the subject of speed in driving is a complicated one because it also involves other psychological factors such as the pleasure that drivers get from driving at high speeds (De Pelsmacker & Janssens, 2007; Delhomme, Chaurand & Paran, 2012) as well as the desire to overcome distances in the shortest possible time (Tay, 2005) both of which are often present in a considerable number of drivers who speed (Yamada, 2005). There are, also, economic interests of the automobile and oil industry both of which actively push for more unrestrictive regulations on the use of the automobile (Yamada, 2005).

Studies have been carried out to investigate the relationship between speed and accidents (De Pelsmacker & Janssens, 2007, Steg & Brussel, 2009; Yamada, 2005) with the main objective of seeking evidence to prove the influence of speed on the frequency and severity of traffic accidents. The influence of speed on serious and fatal accidents is greater than its influence on total accidents (with or without victims). In fact, research suggests that an increase of 10% on average speed can lead to a 30% increase in the frequency of serious and fatal accidents (Lopes, 2006).

It should be noted that even a slight increase in speed can increase the possibility of being involved in a serious accident. As a matter of fact, studies have indicated that even an increase of 5 km/h above the limit of 60 km/h on urban roads and an increase of 10 km/hr on rural roads are sufficient enough to double the risk of serious/fatal accidents (Yamada, 2005; Li, Ma & Liu, 2012). In another study, it was established that the risk of fatality at 50 km/h was double the risk of fatality at 40 km/h and at least 5 times more than the risk of fatality at 30 km/h (Rosen & Sander, 2009).

Driving at a high speed reduces the driver's ability to control the vehicle particularly when it comes to navigating corners and avoiding obstacles on the road. In addition to that, over-speeding has a negative effect on the ability of the driver to estimate the distance needed for braking adequately and also the ability of the driver to react in emergencies (Soole, Watson & Fleiter, 2013). Many drivers commit errors by driving at high speeds even in situations that do not require high speeds hence having a big influence on the likelihood of accidents occurring (Delhomme, Chaurand & Paran, 2012). In total, over-speeding contributes to up to 30% of fatal accidents (Lopes, 2006).

The Theory of Planned Behavior is commonly used to predict intention of drivers to over speed. More specifically there are three elements of the theory that are important in predicting speeding behavior among drivers: drivers' attitudes, subjective norms and perceived behavioral control (Ketphat, Kanitpong, & Jiwattanakulpaisarn, 2013). Attitudes refer to the driver's inherent beliefs while subjective norms refer to social pressures from important elements of the social environment such as friends and other road users. Lastly, perceived behavioral control refers to the individual degree of control over a certain behavior, in this case driving (Letirand & Delhomme, 2005).

Exceeding the speed limit is a common violation among young male drivers (Zuckerman, 2007; Letirand & Delhomme, 2005; Ulleberg & Rundmo, 2003). According to Letirand and Delhomme (2005) young male drivers pass through a lot the speed limit when they estimate intention to over speed, attitude and perceived behavioral control. However, all the respondents in the study agreed that all their important social connections approved observing speed limits and disapproved of them over-speeding by at least 20 km/h. The study also established that the attitude of the driver was by far the best predictor of intention to over-speed by at least 20 km/h when driving on a 90 km/h road (Letirand & Delhomme, 2005). However, recent studies have also suggested that factors such as past behavior and descriptive norms also have a direct influence on intention to over speed (Lopes, 2005; Ketphat, Kanitpong, & Jiwattanakulpaisarn, 2013).

Driving behavior often changes from time to time; drivers can choose to follow other drivers' driving patterns and can also adjust their own speed and driving behavior based on the behavior of other drivers and other road users such as pedestrians (Haglund & Aberg, 2002).

It is quite evident then that both endogenous factors (which are the conditions of the drivers) and exogenous factors (those relating to the external driving environment) interact to determine speeding behavior among other driving behaviors (Letirand & Delhomme, 2005). Taking into account the both the endogenous and exogenous factors can therefore enable the prediction of speeding behavior among drivers (Letirand & Delhomme, 2005).

However, while drivers exercise some control of their speed, research also suggests that their driving speeds may be influenced by their perceptions of the speed choices of other drivers (Haglund & Aberg, 2000). Ultimately, drivers may adjust their speeds (as well as other driving behaviors) based on their perceptions of how fast other drivers are. However, studies from Yamada (2005) and Lopes (2006) have indicated that many drivers tend to erroneously estimate the speed and behavior of other drivers. A significant portion of the available evidence shows that drivers may overestimate the speed of other drivers (Lopes, 2005). For example, a study conducted by Aberg, Larsen, and Beilinsson (1997) established that drivers thought that other drivers drover faster than 60 km/h when driving at 50 km/h roads when in reality only between 16% and 25% of other drivers did so. In addition, the study established that many drivers estimated the speed of others to be 8 km/h to 10 km/h higher than the actual observed speeds of other drivers (Aberg, Larsen & Beilinsson in 1997).

Drivers who drive above the allowed speed also have misconceptions about their speeding behavior (Haglund & Aberg, 2002). For example, one study found that 85% of drivers tend to think that their speeds are lower than the speeds of other drivers (Walton & Bathhurst, 1998). According to a study by Letrirand and Delhomme (2005) up to 47% of the discrepancy in reported behavior may be explained by the intention of the driver to speed as well as the driver’s perceived behavioral control. According to Zamel (2009) drivers often underestimate their speed even when it is relatively high. Subsequently, they choose to drive at speeds that are greater than that which is required.

Drivers do not take into account the impact of initial speed on overall time except when accelerating (Fuller, Park & Carrasco, 2009). This negligence of speed causes people to judge time saved mainly based on the highest speed which leads to the false belief that the higher the speed they are trying to attain, the more time they will save (Hutz, Nunes, Silveira, Serra, Anton, & Wieczorek, 1998). However, the initial velocity strongly affects the potential because a difference of 10 kilometers per hour, for example, can mean more timesaving at lower speeds than at a higher speed (Bartholomeu, 2008). According to Peer and Rosenbloom (2013) when drivers were asked to estimate the time saved when it is increased at a speed of 40 kilometers per Hour at 50, 60 or 70 kph (for a radius of 20 km) drivers underestimated the time saved (on average) 15% below the actual time that could be saved. Drivers estimate the time they can save when they increase from 40 to 60 kph as 4.6 min on average instead of 6 min, which could actually save (Peer & Rosenbloom, 2013).

Control over speeding is important and one possibility of controlling speed is through the use of regulations (Haglund & Aberg, 2002). Although the relationship between speed and accident risk is complex, a considerable amount of research shows that the lowest speed limits result in fewer accidents and those that occur are of lower severity (Yamada, 2005; Lopes, 2006; Jones, Sauerzapf & Haynes, 2008). Because it, reducing speed brings obvious potential public health benefits (Jones, Sauerzapf & Haynes., 2008; Sauerzapf & Haynes, 2008). Then, if is the case, interventions involving the identification and punishment of drivers who exceed the speed limit may have significant potential for reducing the frequency of accidents (Sampaio, 2012). Recently in the Brazilian cities as São Paulo and Curitiba decreased the speed limits in some streets.

Technology can also be used to control speeding behaviors. A common example of the use of technology in speed control is electronic speed surveillance which can be defined as the use of electronic means to supervise adherence to the speed limits established by the transit authorities and to detect and identify those driving above the speed limits. Ultimately, such drivers are fined for non-compliance with transit regulations (Gold, 2003).

Speed control was one of the first necessities arising with the advent of the automobile (Silva, 2008). Given the difficulty of measuring the speed of vehicles by traffic agents, the need arose to develop equipment that could measure speed automatically and reliably. The effect of the average speed is particularly strong in accidents at junctions, suggesting that strategies aimed at speed reduction at intersections have a great potential for reducing accidents (Letirand & Delhomme, 2005; Silva, 2008). Speed control technologies at fixed locations create a speed reduction effect at the location where they are physically in control and in the immediate surrounding areas (Mountain, Hirst & Maherb, 2005).

One of the best examples of electronic speed surveillance technology is the radar speed display which controls speed by making the driver aware that he or she is driving at a speed that exceeds speed limits (Williamson, Fries & Zhou, 2016). Various studies suggest that the use of radar display signs may lead to speed reductions of between 1 mph and 33 mph; others have suggested an average speed reduction of between 2 mph and 6 mph (Gold, 2003; Silva, 2005; Williamson et al., 2016). Zaidel (2002) found that automated speed control had the effect of triggering a 19% reduction in the number of accidents and 17% when considering accidents with victims. The study also found that radars have a greater effect in urban areas which experienced up to 28% reduction in accidents than in rural areas which only experienced a 4% reduction in accidents (Zaidel, 2002).

In France, traffic fatality rates were for a long time higher than those of other OECD countries. In 2000, for example, the traffic fatality rate was 13.6 per 100,000 inhabitants, compared with 9.1, 7.7 and 6.7 for Germany, Finland and Sweden, respectively. Speed limit violations were a major concern for the French authorities. More than 60% of all speeds recorded exceeded prescribed speed limits being 40% more than 10 km/h (ONISR, 2006).

In order to improve the situation, President Chirac announced, in July 2002, that the reduction of the traffic fatality rate was among the priorities of his next five-year term. A few weeks later, three distinct traffic safety measures were announced: (1) installation of speed cameras (2) more stringent fines for traffic violations and (3) the creation of new types of traffic offenses (Carnis, 2011). After it, a study conducted on a sample of 1000 drivers in France by Carnis (2011) found that 61% of respondents reported that average speed control is a good initiative, 54% believed it promotes driver responsibility and 17% suggesting that the system has produced road safety benefits.

Critics of the use of speed cameras argue that speed cameras do not recognize the extenuating circumstances of the speeding behavior (such as a medical emergency). Some drivers also claim that speed cameras may negatively affect the attention of the driver since he/she is more focused on looking at the speedometer to ensure they are within the speed limit (Soole et al., 2013). The braking and acceleration movement often seen near locations that have fixed or mobile speed radars has been evidenced to have a negative impact on traffic flow (Soole et al., 2013).

In Brazil, the use of electronic speed surveillance tools has grown rapidly in recent years, especially in big urban centers. This is despite challenges such as chronic structural problems as lack of equipment: cars, computers, lack of staff and insufficient training (Cannell, 2001). The use of electronic speed monitoring in metropolitan regions and mediumsized cities has shown good results in terms of reducing the number of deaths and major accidents (Cannell, 2001). According to statistics from different traffic management agencies in several Brazilian cities, accidents have experienced a reduction of 30% on average (Cannell, 2001).

In the city of São Paulo, normal speed enforcement began in 1997, with a 31% reduction in the number of fatalities between 1996 and 1998 (Yamada, 2005). In the state of Paraná, on the highway BR-116 in the stretch between kilometers 86 and 94, there was a reduction of 57% in the monthly average of accidents with the installation of electronic radars (Yamada, 2005). In the other part of the country, the results of the state of Santa Catarina show that the main effect was a 42% reduction in accidents of greater severity (Yamada, 2005). The deactivation of the equipment reversed this picture. In the six months in which electronic radars were deactivated in 1995, compared with the same period in 1994, there was a 21% increase in total accidents and a 54% increase in the number of deaths (Yamada, 2005). The use of electronic speed surveillance tools in Brazil's road network is more recent. They are mainly used on highways that cut the urban fabric and in concessioner highways which because of a contractual agreement with the Granting Authority are obliged to implement electronic speed surveillance (Yamada, 2005).

However, the most serious problems for Pasa (2013) are urban crossings, where the highway intersects urban areas subsequently generating conflicts of interest between the flow of passing traffic and local traffic. This, together, with the conditions of use and occupation of the land at the edges of the highway aggravate traffic problems (Yamada, 2005). Then, at the end of the 1990s, the National Department of Roads (DNER) initiated a program to install 667 surveillance tools in critical selected sections (Cannell, 2000).

According to Cannell (2000) electronic speed surveillance is one of the most efficient means of speed control because it performed for 24 hours a day and the offender is detected and identified by photographic record. Electronic surveillance also allows the agent of the transit authority to issue the notice of infractions, based on legal provisions defined in Law (Law No. 9,503 of 09/23/97, of the Brazilian Traffic Code) (Brazil, 1997).

In Brazil, Electronic Speed Surveillance is a controversial issue generating intense arguments. For example, there are those who feel that these surveillance systems only serve the purpose of generating money; others raise issues of invasion of privacy as well as other legal issues (Gold, 2003). Another challenge of electronic speed surveillance in Brazil is that few people, including those in the transportation and transit industry, have basic knowledge on what electronic surveillance is, how it works and where it is used (Gold, 2003). Many others are unaware of the permitted speed limits in the country. The Brazilian Traffic Code (Brazil, 1997) establishes that the maximum permitted speed in urban areas is 60 km/h (arterial roads), 40 km/h (collecting roads) and 20 km/h (local roads). Further these speed limits are subject to modification by the corresponding managing body of the road system. Often, drivers cause serious accidents because do not respect these speed limits (Féris, 2003).

Nonetheless, Pasa (2013) contends that speed control technology should be used together with other speed reduction measures such as education and awareness campaigns, stringent penalties for speed violations and other speed reduction programs. According to Silva (2008), awareness campaigns and public education are not effective in dealing with ongoing spending. The immediate solution to over speeding is technology such as Speed Surveillance Cameras (Mountain, et al., 2005). Lower speeds are associated with long-term economic benefits due to the reduction of costs associated with accidents (Soole et al., 2013). Research also suggests that the incentive of lower fuel consumption (when driving at low speeds) could be used to inspire drivers to reduce their speeds. However, such findings are sparse and are mostly from countries where the underlying goal of the system implementation was to enhance air quality (Soole et al., 2013).

2.6 Eco-Driving

Fuel consumption in the transport sector contributes to the emission of greenhouse gases in general, and in particular, has the effect of increasing CO2 emissions (Saboohi & Farzaneh, 2009). The emission of CO2 is often a function of factors such as the vehicle's state of technology (how new or old it is) and traffic congestion among others (Rakha & Ding, 2003).

Andrieu and Saint-Pierre (2012) assert that good driving is one of the most efficient and effective solutions in the reduction of greenhouse gas emissions from surface transportation and more so, from cars. However driving safely is a highly complex task consisting of numerous driving tasks (Zarkadoula, Zoidis & Tritopoulou, 2007). For example, the driver needs simultaneously control the vehicle, adjust its speed and trajectory according to the driving environment, handle risks and make strategic decisions such as navigation towards the driver’s intended destination (Rakha & Ding, 2003). In the current era of energy conservation and eco-friendliness many drivers have a new goal in mind: fuel efficiency. Research suggests that eco-driving can lead to a reduction in CO2 emissions by up to 30% (Rouphail et al., 2001).

Improved energy efficiency and improved vehicle design has considerably reduced the amount of CO2 emissions in the last three decades (Zarkadoula et al., 2007). At the same time, however, the number of vehicles has increased significantly in different parts of the world in the period between 1980 and 2007 (Shukla & Alam, 2010). In Brazil, for example, the number of cars increased from just over 136 cars per 1000 inhabitants in 2001 to 250 cars per 1000 inhabitants in 2012 (Observatory, 2013). In France, on the other hand, there was an average of 570 cars per 1000 inhabitants (Ministry of Interior, 2006).

Thijssen, Hofman and Ham (2014) point out that there is an ongoing trend to reduce fuel consumption. The most common motivation for this is to reduce the negative environmental impact of fossil fuels and also to reduce dependence on oil which is fast becoming a scarce and volatile resource. Because of the increased focus on the environment and sustainable practices, car manufacturers are putting a great deal of effort into reducing CO2 emissions (Thijssen, Hofman & Ham et al., 2014).

However, despite the effort of car manufacturers, the truth is that the mileage per liter of fuel from a very efficient vehicle can significantly reduce if that vehicle is driven in a manner that is not good i.e. reflective of misconduct (Zarkadoula et al., 2007; Thijssen et al., 2014). Greater improvements can therefore be made by encouraging drivers to drive vehicles in a safer and more efficient manner. For this to happen, it is necessary for drivers to demonstrate a willingness to change their driving behavior (Zarkadoula et al., 2007).

Driving can be divided into three main stages: accelerating, driving at cruise speed, and braking (Marchau & Jiménez, 2008). During each phase, different factors influence the fuel consumption. During acceleration, the gearshift behavior is of paramount importance (Marchau & Jiménez, 2008). The higher gear results in fewer engine revolutions per unit of distance traveled; therefore, less energy dissipated by motor drag factors (e.g. air intake losses). Thus, during acceleration, the fuel can be saved by upshifts at low engine speeds (Thijssen et al., 2014).

In the cruising stage, two factors are of importance: engine drag and air resistance. When braking, the kinetic energy generated by the engine of the vehicle is converted to heat because of the friction caused when braking (Thijssen et al., 2014). Because of the above-mentioned gear selection effect, lower speeds (lower gears) produce a larger drag while at higher speeds, air resistance becomes increases, due to its quadratic relationship with vehicle speed (Mandava, 2009; Yang, 2010). A speed of 65-80 km/h for passenger cars is therefore recommended for drivers to achieve better fuel economies (An & Ross, 1993).

When driving a conventional car, braking has the effect of converting the kinetic generated by the engine into heat energy (Clegg, 1996). This is because of the friction breaks (in passenger vehicles) and/or engine and transmission brakes (Sharma, Madaan & Verma, 2013). According to Thijssen et al. (2014) when the accelerator pedal is released, the fuel supply to the engine is cut off, and no fuel is consumed. Drivers seeking to reduce fuel consumption are therefore advised to release the accelerator pedal earlier and before using the brake as this would significantly decrease fuel consumption (Yang, 2010; Mandava, 2009).

Eco-driving is defined as the adoption of driving styles and behaviors that reduce the consumption of energy (Stillwater & Kurani, 2013). In a broader sense, eco-driving could be interpreted as all behaviors related energy saving in the context of vehicles. These include not only the actual driving behavior but also all other practices related to driving e.g. maintenance behavior, modes of travel and the choice of the vehicle (Stillwater & Kurani, 2013).

Eco-driving has been recognized as a potential source of reduced transportation energy consumption although estimates of energy savings vary widely from less than 5% to as high as 20% depending on driving behaviors and practices (Stillwater & Kurani, 2013). Studies have also shown that aggressive driving based on sudden acceleration and deceleration results in fuel wastage of about 33% on high-speed roads and approximately 5% fuel wastage when driving around cities. Therefore, the acceleration should be quite smooth (Saboohi & Farzaneh, 2009) to be environmental good.

The main goal of eco-driving is to enhance and improve the local environment by improving driving behavior by reducing the driver anger behavior impact and the flow of local traffic (Barth, 2011). In addition to that, eco-driving also leads to cost savings in the form of reduced fuel costs and maintenance costs (Saboohi & Farzaneh, 2009).

It should be noted that the idea of eco-driving is relatively old. The first concepts of eco-driving were prepared in Germany in 1986, courtesy of the Technical University of Berlin supported by Volkswagen (Abu-Lebdeh, 2010; Yang, 2010). However, eco-driving was only integrated into the practical and theoretical parts of novice/learner driving courses in 1999 (Luther & Baas, 2011).

Several factors have been found to have an influence on eco-driving. Among the most important of these include: vehicle class selection; selection of the vehicle model; selection of vehicle configuration; engine adjustment; tires; motor oil; selection of road types; selection of degree profile; dealing with congestion; weight; slow running; speed / RPM; use of cruise control; use of air conditioner and aggressiveness of driving (Driel, 2007; Duivenvoorden, 2008).

In addition, there are several ways through which drivers can learn eco-driving behaviors. For example, it is possible to learn eco-driving habits by reading some driving tips or taking a professional course (Driel, 2007; Duivenvoorden, 2008). Equally, one may choose to do hands-on exercises with vehicles that have been pre-equipped with electronic help (Driel, 2007; Duivenvoorden, 2008). However, there is still an overwhelming need to understand the best way to teach and learn eco-driving behavior, especially among young drivers. According to some studies, even reading simple advice on eco-driving allow drivers to reduce their fuel consumption (Andrieu & Saint-Pierre, 2012).

Eco-driving tips and advice on eco-driving can also be obtained from both government and private initiatives dedicated to the eco-driving concept. For example, the Dutch government has launched outdoor and television campaigns to promote eco-driving (Instituut voor Duurzame Mobiliteit, 2012). In addition to that there are many other private companies specializing in classroom training or vehicle training on eco-driving behavior (Stichting Ecodriving Nederland, 2013).

According to Thijssen et al. (2014) drivers can adopt certain practices which can help to reduce fuel consumption. They identify practices such as (i) accelerating moderately with upshifts of between 2000 and 2500 rpm; (ii) anticipating traffic flow signals and avoid abrupt decelerations and stops; (iii) maintaining a consistent pace when driving; (iv) driving at or below the speed limit; and (v) turning off the engine during short stops. Adopting the aforementioned practices will increase the efficiency of driving and subsequently, lead to less fuel consumption (Thijssen et al., 2014). However, even when pursuing this smooth driving style that is synonymous with eco-driving, drivers must ensure they interact with other road users and various driving situations in a safe manner (Agresti, 2002; Hosmer & Lemeshow, 2000). Another key factor in eco-driving is time and more so, the reaction time of the driver. Drivers must be able to make safe and appropriate decisions and execute them in real time (Dogan et al., 2011).

Eco-driving strategies have the potential to reduce fuel consumption in the transport industry (Bideaux, Trigui & Tattegrain, 2013). Theoretically, in an urban traffic environment with the free flow, fuel economy can be improved by up to 34% (Andrieu & Saint-Pierre, 2012). In practice, however, the real improvement in fuel economy as a result of eco-driving drops slightly. According to Theall (2011), eco-driving can result in fuel economy improvements of between 5% and 26% depending on different vehicle types as well as different drivers. These findings are a strong indication that eco-driving is an effective way of cutting down on fuel consumption (Thijssen et al., 2014). However, studies also suggest that the positive effects of eco-driving may not be so long lived. For example, some researchers have found that the improvements in fuel economy are only experienced for a short time after taking an eco-driving course (Bideaux et al., 2013).

Dogan et al. (2011) point out that driving behavior often depends on the aims and motivations of the driver. However, drivers may have several objectives at the same time (Hosmer & Lemeshow, 2000; Agresti, 2002). When multiple objectives are active, drivers have to prioritize some goals over others and will do it based on the importance of individual goals as well as based on changes in the driving environment (Lanza & Verdolini, 2011). This is further complicated by the fact that in situations of dynamic changes in the driving environment, the priority of the competing goals may quickly change based on the specific changes that have occurred (Dogan, et al., 2011).

The heavy mental workload plays a huge role in influencing the driving style of the drivers. This is because sudden and rapid changes in the driving environment necessitate different driving behaviors to meet the newly prioritized goals. Indeed, empirical evidence shows that in demanding situations i.e. emergencies, the goal of fuel economy is not a top priority goal (Barkenbus, 2010).

Another way of learning eco-driving behavior is through the use of intelligent driving systems in cars. Yet there are those who argue that these assistants could be distracting to drivers. In their study, Rouzikhah, King and Rakotonirainy (2013) concluded that on-board information systems do not significantly increase the mental workload of drivers and therefore, did not make them distracted. This means that though there is a risk of the eco-driving messages distracting the driver, the risk is not high enough to cause distractions on manual tasks and cognitive demands (Rouzikhah et al., 2013). In the same way the findings from Birrell and Fowkes (2014) pointed out that drivers that use intelligent driving devices spend an average of 4.3% of their ergonomically looking at the system. The researchers recommend designing such systems in a manner that is friendly for drivers and in line with the principles of interface design. The use of an intelligent system with an adaptable interface would lead to fewer visual distractions (Birrell & Fowkes, 2014).

Other common eco-driving technology is real-time feedback systems (Hypermiler, 2012). These systems give instant feedback based on current operating conditions of the driver (Hypermiler, 2012). Examples of such systems are guiding, mile-per-gallon meters, acceleration/deceleration feedback, and active pedal accelerator (Thijssen et al., 2014). Short-term feedback systems provide feedback over a relatively short period. This allows drivers to track their average performance on the road. They include systems that use symbols or colors to indicate fuel efficiency and systems that give scores for various aspects of driving style (Thijssen et al., 2014).

Systems give feedback over long periods. This allows drivers to track their progress in the end. However, it does not allow drivers to note the direct effects of a change in driving style (Thijssen et al., 2014). According to one study, test pilots averaged 9.5% of fuel economy at the cost of 4.6% of the additional travel time for the anticipatory behavior. However, to achieve this result, drivers must perform perfect maneuvers or, in case of limited visibility, anticipate situations perfectly as soon as visibility reduces (Thijssen et al., 2014).

Eco-driving is also determined by factors inherent to the driver. For example, research shows that drivers consistently tend to overestimate the amount of time they could save by increasing their speed; this may help to explain why time saving is so heavily valued (Dogan, et al., 2011). There are other factors that influence the ability of a driver to adopt eco-driving behavior. To Strömberg & Karisson (2013) contextual factors, such as the time constrains, and the need to meet schedules, as well as having to follow a predetermined course, can limit the ability of drivers to implement eco-driving practices.

It is suggested that eco-driving behavior is more likely to be adopted by drivers with a particular set of psychological conditions that include attitudinal alignment, with more behavioral control (An & Ross, 1993; Stillwater & Kurani, 2013). Although the aforementioned projected fuel savings of between 5% and 26% are promising, research shows that the long-term effects of eco-driving training on fuel economy may be less significant, with 5%-10% numbers in three years and 2%-3% after three years (Stillwater & Kurani, 2013). Among some drivers, however, eco-driving may not result in any positive impacts on the driver’s own financial situation. Among such drivers, the motivation to adopt eco-driving practices may be significantly lower than among other drivers (Ando & Nishihori, 2011).

It is possible for drivers engaging in eco-driving practices to influence and trigger similar behavior among other drivers on the road (Kramer & Rohr, 1982; Spence & Ho, 2009). Cars often follow other cars for approximately 7% of the driving time (Kramer & Rohr, 1982; Spence & Ho, 2009). This means that there is a significant possibility for a car that is being driven in an eco-friendly manner to influence other cars to move economically and ecologically (Ando et al., 2010; Boriboonsomsin et al., 2010; Greene, 1986; Larsson & Ericsson, 2009; Lee, Lee, & Lim, 2010; Satou et al., 2010; Syed & Filev, 2008; Van der Voort, 2001; Wahlberg, 2007).

2.7. Driver Behaviour Questionnaire

The Driver Behaviour Questionnaire, also known by its acronym: DBQ was developed by Reason et al. (1990), more than 25 years ago. Since then it has been widely used to study the drivers' behaviors (Gras et al., 2006, Lajunen & Summala, 2003, Lawton, Parker, Manstead & Stradling, 1997; Reimer et al., 2005). The DBQ has been used in cross-cultural studies (Lajunen, Parker & Warner; Özkan & Lajunen, 2010), and to examine the effects of age on driver behavior (Dobson, Brown & Ball, 1999), social desirability (Lajunen & Summala, 2003), parental influence in the children's driver behavior (Bianchi & Summala, 2004), control of speed (Warner et al., 2004), and traffic accidents among drivers of 4x4 vehicles (Bener, Özkan & Lajunen, 2008).

It is an instrument that measures, by way of self-reporting, the frequency of three-risk behaviors in the driving: (a) errors of insufficiency of actions planned to reach the objective and that, as a consequence, can have potentially dangerous results; (B) intentional violations of practices deemed necessary to maintain safe driving; (C) attention slips and memory failures that may cause embarrassment but have no impact on driving safely (Reason et al., 1990). The original questionnaire included 50 items describing driver behavior in traffic that were classified into three different categories: violations, errors, and lapses (Reason et al., 1990).

Errors and violations result from different psychological processes and must be treated differently (Özkan, Lajunen & Summala, 2006; Steg & Brussel, 2009). Errors are the result of problems in cognitive processing, while violations include a motivational and contextual component of demands (Özkan, et al., 2006; Steg & Brussel, 2009). The main distinction between the concepts of errors and violation is the question of the intentionality of behavior. In violation the driver often knows that his/her actions are not in line with established rules and regulations. On the other hand, errors often occur without the knowledge/ full awareness of the driver (Reason et al., 1990; Davey, Wishart, Freeman & Watson, 2007). Errors can be defined as a generic term to cover all occasions when a planned sequence of mental or physical activities cannot achieve the desired result, and when these failures cannot be attributed to the intervention of any person (Reason et al., 1990). However, it should be noted that both violations and errors are potentially dangerous to cause an accident (Lajunen & Summala, 2003).

DBQ has good psychometric properties and results using the instrument has been relatively consistent (Lajunen & Summala, 2003). Bener, Zirie, Janahi, Al-Hamaq, Musallam, and Wareham (2008) have indicated DBQ as one of the most widely used and reliable instruments to measure driving style. The DBQ scales have shown satisfactory internal reliability. For example, Westerman and Haigney (2000) found Crombach's alphas of 0.76 for the errors' scale, 0.74 for the scale of violations, and 0.74 for the scale of lapses. The individual alpha scores are 0.88 for violations, 0.72 for lapses and 0.62 for errors (Verschuur & Hurts, 2008).

DBQ was later modified by Lawton et al. (1997) to include additional items for the purpose of evaluating other behaviors committed by aggressive drivers (Lawton, et al., 1997). The scale of violations was split into two to distinguish two types of violations: ordinary traffic code violations, which consist of behaviors such as speeding and driving past the red light; and aggressive violations those such as chasing another driver when irritated.

Aggressive drivers focus on gaining advantages and are more hostile in their nature according to Lawton et al. (1997).

Aggressive violations are associated with an aggressive interpersonal component while ordinary violations do not have an aggressive purpose, although they are deliberate (Lajunen & Summala, 2003). For Davey et al. (2007) aggressive violations consist of a mixture of emotional responses oriented to driving situations and traffic code violations. For example, some drivers may show aggressive behavior to pedestrians crossing the road by driving extremely close with the purpose of forcing them to cross the road faster (Davey et al., 2007). Thus, the contextual and motivational demands of the moment have a great influence on violation. Currently the DBQ has four scales Errors, Lapses, Ordinary and Aggressive Violations.

The relationship between driving violations and traffic accidents has been well established over the decades (Xie & Parker, 2002). On the violations, research shows that the involvement of drivers in accidents can be predicted through self-reporting for the tendency to commit different types of violations (Gras, Sullman, Cunill, Planes, Aymerich & Font-Mayolas, 2006; Özkan & Lajunen, 2005b).

The issue of youth was discussed by Reimer and Kuehn (2005) whose DBQ results showed that high scores of violations in youngsters were statistically related both to involvement in previous accidents and to the likelihood of involvement in a future accident. Young drivers were identified as a particularly high-risk group, with driving behaviors being the main reasons for involvement in accidents among young males 4x4 drivers (Bener et al., 2008). Özkan and Lajunen (2005b) reported a correlation between ordinary violations and accidents of 0.35. A review of Stradling, et al. (1998) indicated that violations, not errors were predictive of accidents. In the same way, DeLucia, Bleckley, Meyere and Bush (2003) found that the violations predicted accidents. Xie, Zhao and Huynh (2012) found that the violations were associated with active and passive accidents. Similar results have been established in samples from different countries (Gras et al, 2006; Kontogiannis, Kossiavelou, & Marmaras, 2002; Sullman et al., 2002);

Older drivers tend to commit violations less frequently than younger drivers (Bener et al., 2008, Kontogiannis et al., 2002, Parker, Lajunen & Stradling, 1998). In the correlation between DBQ and age factors for Verschuur and Hurts (2008) the driver of less than 50 years is more likely to commit violations compared to older drivers. In Westerman and Haigney (2000), respondents aged between 30 and 35 years had the highest score in the ordinary violations factor. For Özkan and Lajunen (2005), some types of violations can be highly adaptive, although they are still violations. This is because strict compliance with rules and regulations may actually be inadequate in some situations. For example, one may choose not to stop at a red light in order to avoid being a victim of assault or a kidnapping (Özkan & Lajunen, 2005). This is quite common in Brazil. Similarly, a fire truck may drive on the wrong lane for the purposes of getting to its destination faster.

Also the errors have been related to involvement in active accidents (those in which the driver was responsible), while involvement in passive accidents (those in which the driver only suffered the accident) was associated with high scores in the lapses factor (Parker, McDonald, Rabbit & Sutcliffe, 2000). However, Verschuur and Hurts (2008) have noted an issue about lapses: to report how often a driver has had a lapse he should be able to remember these lapses. Freeman, Wishart, Davey, Rowland and Williams (2009) reported positive correlations (0.16) between errors and accidents.

However, the literature is not homogeneous. Although the important application of the description of individual differences in involvement in accidents, there are still results indicating that it is not clear to what extent DBQ can predict this involvement (Winter & Dodou, 2010). In Blockey and Hartley's (1995) study neither error nor violations emerged as significant predictors of accidents. In the meta-analysis performed by Winter and Dodou (2010), errors and violations were positively correlated with self-reports of involvement in accidents, being the predictive violations of accidents among young drivers, but not between older drivers. Violations decrease with age, but the increase in the number of miles rotated is related to a higher score in violations, while the score in the errors factor increases with age (Winter & Dodou, 2010).

For Westerman and Haigney (2000), changes in driver behavior are consistent with a decline in driving ability over the years. For the elderly population, DBQ was predictive of involvement in accidents, as these populations made more errors compared to young drivers with a positive correlation between failure and accident reports (Bener et al., 2008). This research established that older drivers make more mistakes than younger drivers. Perhaps this may be explained by the loss in cognitive functions among the elderly. Yet in another study, elderly people who were considered less adventurous were more likely to make driving mistakes (Owsley, McGwin & McNeal, 2003).

Regarding gender differences, male drivers appear to be responsible, especially for drinking and driving violations, as well as for making more mistakes and violations (Veiga and Pasquali & Silva 2009). Aggressive Violence factor was positively related to men (Kontogiannis, 2006) suggesting that men are more prone to aggressive driving than women (Javanovic et al., 2011). Bener et al. (2008), Shi, Bai, Ying and Atchley (2010) and Winter and Dodou (2010) have found similar results regarding violations, but state that women make more mistakes than men. However, female drivers tend to make less serious mistakes than male drivers (Özkan & Lajunen, 2005). A result inconsistent with previous studies was that of

Xie and Parker (2002) who found that male and female drivers did not differ in violations' frequency.

For Xie et al. (2012) the DBQ items describe only a few specific behaviors, while traffic accidents occur across a much wider range of situations and can be caused by error-conducting behaviors far beyond the scope of the agencies covered by DBQ. It seems reasonable to ask whether there may be some basic behavioral differences between drivers with high DBQ scores and those with low DBQ scores. This could be useful in explaining differences in collision rates as driving behaviors portrayed in the DBQ do not usually result in an accident (Gras et al., 2006; Kontogiannis, et al., 2002; Sullman, et al., 2002)..

The relationships between the DBQ scores and the actual driving behavior provide links between the behavior and the accident rates (Xie et al., 2012). Although it seems unrealistic to assume that each driver's DBQ score is a fully accurate reflection of his / her driving style and ability, this data suggests that DBQ is a relatively easy measure that can be used to identify the potential of increased risk behavior in drivers (Zhao et al., 2012). Åberg and Warner (2008) note that the DBQ instrument can be used for long-term predictions of all driver behaviors. They demonstrated this through a longitudinal study where an applied questionnaire explained between 24% and 26% of the variance of the excess speed that was registered 18 to 20 months later (Åberg & Warner, 2008).

DBQ is a measure of driving style and to Martinussen, Mølle and Prato (2014) driving style and driving ability are crucial factors when examining a person's ability to drive safely. Driving style generally refers to the way the person prefers or habitually drives the car, while the driving ability refers to how skillful an individual is in controlling the car (Elander, West, & French, 1993).

For Davey, Wishart, Freeman, and Watson (2007) the DBQ provides a proactive perspective on the type of behaviors exhibited by drivers. The instrument also provides the possibility of identifying types of behavior associated with crime and accidents. The use of such measures may assist in the development of interventions designed to reduce the likelihood of an accident before the event occurs (Davey et al., 2007).

Considering differences in demographic factors as well as the special interests of new research, new items were added which created different versions of the original questionnaire (Warner, et al., 2010). Even with these modifications the questionnaire remained reliable for use with amateur and professional drivers, both within and between different countries (Warner, et al., 2010).

Özkan, Lajunen, Chliaoutakis, Parker, and Summala (2006) submit that the DBQ is transculturally valid and stable over time. However, they note that each country has its own problems and challenges due to cultural differences. This stability was found within and between different countries and cultures as in Brazil (Bianchi & Summala, 2002), the Netherlands (Lajunen et al., 2003), the United Kingdom (Parker, Lajunen & Summala 2000), New Zealand (Sullman, Meadows & Pajo, 2002) and China (Xie & Parker, 2002).

According to Veiga and Pasquali e Silva (2009), the initial validation of DBQ in Brazil was presented by Veiga and Flores (2000) and the second work on DBQ in the country was developed by Sousa and Clark (2001). However, both papers were presented only at conferences (Veiga & Pasquali & Silva, 2009). The first publication in an identified scientific journal was that of Bianchi and Summala (2002), who performed the validation of the DBQ version with 28 items for Portuguese.

Bianchi and Summala (2002) applied the DBQ instrument developed by Lawton et al. (1997) with 28 items in a sample of 260 Brazilian students. A factorial structure similar to that of the fundamental DBQ studies was found. Bianchi and Summala (2004) applied the same instrument to 123 university and postgraduate students and their parents. Errors correlate positively between parents and children, as well as ordinary violations, except in cases of mother-child pairs, in which there was no correlation. In aggressive violations, parents' scores correlated positively with those of their daughters (Bianchi & Summala, 2002).

In 2004, Macedo using the QCM (*Questionário de Comportamento do Motorista*, in Portuguese or Driver Behaviour Questionnaire), related violations with safe driving, driver irritability and traffic accident, in a sample of 500 drivers (Macedo, 2004). The QCM version was a smaller version of the original DBQ instrument. In the QCM version, the items of lapses were withdrawn, resulting in a questionnaire of 20 items. Soares (2010) applied the QCM adapted by Macedo (2004) in a population of 262 drivers from Campo Grande - MS. The behaviors were classified according to the categories of QCM, between errors, aggressive violations and violations of the traffic code. The results showed that 36.92% of the non-university students and 40.77 of the university students reported transition above the allowed speed, and that 18.46% of university students and 20.93% of non-university graduates drove drunk (Macedo, 2004).

Veiga et al. (2009) adapted and validated the QCM with 67 items according to the original DBQ of Reason et al. (1990) with the purpose of distinguishing between undesirable behaviors in a portion of drivers from the Federal District. The name given to the questionnaire was *Questionário de Comportamento do Motorista* - QCM. The factorial structure of the questionnaire was the same as that found by Reason et al. (1990).

Monteiro and Günther (2006) verified the relationship between individual variables and inappropriate behaviors of drivers, through a questionnaire with 923 conductors from Brasília that responded to the scale of anger in the direction of aggression and driver violations and errors. The Conduct Violations and Errors Scale (EVEM), with forty items, was developed from the DBQ of Reason, Manstead, Stradling, Baxter and Campbell (1990), with four indexes: errors, violations, aggressive violations and aggressive interpersonal violations. Monteiro and Günther (2006) showed that driving anger can be a mediating variable between aggressiveness and unwanted behaviors of drivers.

Findings from Martinussen et al. (2014) suggest that using a differential approach (including a combination of different intervention strategies) may have certain benefits such as explaining the differences between individual driving behaviors and more importantly, understanding the differences in the psychological processes that influence dangerous driving habits i.e. risk behaviors.

3. Personality Factors and Emotional States

Research has established that the conditions and emotional states of drivers have a direct impact on driving behavior. This is because such conditions may either positively or negatively affect the drivers' ability to process information that is necessary for safe driving behavior (Hutz & Nunes, 2007). Some of the most commonly mentioned emotions in the study of driving behavior are associated with personality, as for example aggressivity (Bartholomeu, 2008).

Traditionally, studies from Åberg et al. (1997), Andrade et al. (2010) and Bacchieri and Barros (2011) on driver safety have focused on the role of the physical environment, vehicle conditions and the driver in causing traffic accidents (Iversen & Rundmö, 2002). In recent years, however, is increasing the number of studies considering the role of psychology in risk behavior and traffic safety. Many of these studies focus on how the emotional and personality factors of the driver influence driving behavior and involvement in traffic accidents (Holland, Geraghty & Shah 2010; Özkan & Lajunen, 2005). The role of personality traits in traffic accidents can be traced back to Chamber's (1939) theory of "accident propensity", which suggested that most accidents are caused by a small number of individuals with certain personality characteristics.

In the literal sense, personality is a word that has its origins in another word, "person". According to Martins (2004), personality is associated with the notion of being a person. The word "person" has its origins in the Latin word "persona" which in turn is synonymous of theatrical "mask" or "character". Personality is therefore a concept that is concerned with how human beings relate with others. More specifically, personality is concerned with how individuals present themselves (in terms of character) to others (Martins, 2004). In addition to that, Martin (2004) asserts that personality is a major determinant and influencer of an individual's behavior.

In the psychological literature there are two approaches to personality: nomothetic and idiographic. The idiographic approach is concerned with analyzing the personality of a single individual or a group of individuals (Grice, Jackson, & McDaniel, 2006). An example could be the study of one driver personality for several years. On the other hand, the nomothetic approach to personality is concerned with describing general truths regarding personality. It should be noted that the nomothetic approach is neither bound by time nor context (Grice et al., 2006).

The nomothetic approach is perhaps one of the most common approaches in personality research. In this approach, traits and types of personality allow individuals to compare themselves to others (Cloninger, 1999). The unique personality of an individual is therefore determined by individuals varying degrees of conformity with relatively stable traits that are generally consistent among people. Thus, the nomothetic approach is also known as the traits approach to personality (Cloninger, 1999). The personality types introduced by Jung (1972) are a good example of the nomothetic approach to personality. Center (2006) points out Eysenck's personality theory as another good example of the nomothetic approach in which 3 major personality traits are identified: extroversion, neuroticism (emotional instability) and psychoticism. Goldberg's 5-factor personality theory is also an example of the nomothetic approach. Mathews, Deary, and Whiteman (2003) argued that this theory identifies 5 major dimensions of personality: extraversion, agreeableness, conscientiousness, neuroticism and openness.

Cloninger (1999) describes how the nomothetic approach is constructed. He notes that in this approach, different individuals are studied and compared by applying the same concepts to every individual. Subjects are often required to take a personality test after which their scores are totaled and compared. The final score is then used to predict the type of personality that an individual may have. Each person receives a score to indicate how much of a particular personality trait she or he has (Cloninger, 1999).

One of the most influential works in regards to personality development is that of Miller and Dollard (1941) who suggest that personality is a construct that includes habits that are formed through learning. Further, they propose that personality development is influenced by various stimuli in the social environment as well as the responses of individuals to these stimuli. In the Social Learning Theory proposed by Miller and Dollard (1941), imitation is identified as a major drive for people. This means that learning can occur from imitation. Imitation is defined as a process by which one individual attempts to copy or emit behavior that is similar to that of another individual (Miller & Dollard, 1941). It is important to note that two distinct forms of imitation are identified; matched –dependent behavior and copying. The former is concerned with the recognition of the cues that trigger a certain behavior e.g. people in a crowd elicit certain behaviors only because other people are behaving in a similar manner. On the other hand, copying is considered more voluntary and deliberate in that individual knowingly adopt behaviors that are similar to another person (Miller & Dollard, 1941). Imitation is a key element of the social learning process and ultimately, it is important to personality.

Personality is seen as an important determinant of driving risk behavior (Constantinou et al., 2011). For example, close links have been established between extraversion and an increased likelihood of engaging in risk behavior (Oprea, 2012). In the same way, individuals with high levels of self-control are less likely to engage in risk behavior (Ferreira et al., 2009).

A growing body of research (Rivis et al., 2011; Scott-Parker et al., 2009) has established that the act of driving is not limited to motor or cognitive skills, but also involves emotional aspects. In addition, drivers are necessitated to learn the formal and informal rules of driving. Perhaps more importantly, drivers should learn how to anticipate risk situations in different contexts. Ultimately, drivers adjust their feelings or emotions according to the prevailing traffic situation (Spagnhol, 1985).

Emotional states of drivers have a direct impact on driving behavior and constitute direct human causes of accidents (Constantinou, et al., 2011; Bartholomeu, 2008). This is because different emotional states affect the ability of drivers to process relevant information, which ultimately has an effect on driving behavior and more specifically, the ability to drive safely (Bartholomeu, 2008). All emotional conditions are associated with personality (Treat et al., 1977). Indeed, research has established (Bartholomeu, 2008; Arnett, 1990; Arnett et al., 1997) that emotional conditions such as anger, stress, anxiety, aggression and anguish among others greatly increase the likelihood of risk behavior and accidents.

The personality as defined by Cloninger (1999) has patterns characteristic of thinking, feeling and acting that tend to be stable throughout life: the traits. However, some behaviours are not always part of personality, they can also be an emotional state in reaction to an event. It is the case to aggressiveness, anger and anxiety (Nascimento, 2006; Capitão & Tello, 2004). Emotional states are transient and dependents from the situation (context, social interaction, and so on). The trait of aggressiveness is defined as a strong predisposition to experience anger more often (Silva, 1988). Regarding the act of driving, the trait aggressiveness refers to how much a driver becomes irritated when driving (Deffenbacher et al., 2003). The trait is connected with action and to assess how drivers express anger during driving situations Deffenbacher, Lynch, Oetting and Swaim (2002) developed the Anger Expression Inventory (DAX). On the other hand to assess the anger of drivers reported in potentially irritating situations (state) Deffenbacher, Oetting and Lynch (1994) developed a scale (DAS)

Thus, certain personality traits could negatively affect drivers' behaviors in traffic, and may increase their likelihood of accidents. Despite this, it is often challenging to investigate how personality impacts the behavior of drivers (Ferreira et al., 2009). This is because observations of personality must be made (deduced) from observing the behavior of individuals. Bazi (2003), from the perspective of the Trait Theory, points out that a variable and a constant part exists in the conduct of the subjects. The constant part is known as a trace and is encoded in the individual every time the individual is exposed to certain information. On the other hand, it is assumed that an individual's traits are variable meaning they can change based on different contexts and situations (Bazi, 2003).

At present, the Big Five Factors (CGF) Theory is considered a modern version of Trait Theory, describing basic personality dimensions in a consistent and replicable way. However, a common criticism of the Big Five Factors Personality is that it is not based on any underlying theory (Cuffa, 2016). On the contrary it is based on empirical findings from other instruments aimed at measuring personality such as the 16-Personality Factor Questionnaire (16PF), the Minnesota Multiphasic Personality Inventory (MMPI) and the Murray Needs Scale, among others all of which offer similar solutions as the CGF model, regardless of the theory underlying these tests (McCrae & Costa, 1989; Digman, 1990; McAdams, 1992; Briggs 1992; Hutz et al., 1998; Bartholomeu, 2008).

Considering that the CGF model originated in the analysis of the language used to describe people, the use of trait descriptors (in general adjectives) is presented as one of the methods of identifying the aforementioned personality factors (Hogan, 1996). For Goldberg (1982), if a certain trait was distinctly evident in an individual, then other people with the social environment of the individual would notice the trait and talk about it. According to Hogan (1996) a certain word would be used to describe such an aspect as a result.

It is important to note that there are still some diverging views regarding the classification of personality factors (a structured and defined part of the personality, e.g., the internal control factor) and trait (how the personality became present in a determinate moment, e.g. to become angry in a conflicting situation).

The characteristic of each dimension does not represent a methodological or epistemological problem, and its importance lies in the ease of communicating it. In this context, authors such as Goldberg (1981) and Hogan (1983) sought to organize factorial solutions guiding the current understanding of the five possible personality factors.

In the Big 5-Factors Personality Theory for example, the first factor of extroversion/ introversion corresponds to the first factor of the Eysenck’s 3-factor personality theory and also to Guilford’s social activity factor (Campbell & Reynolds, 1984). People with high scores of the extroversion factor are often characterized as unconcerned, impulsive, spontaneous, adventurous, sociable, assertive, active and lively (Hutz et al., 1998). The Big 5 factor theory also includes the three factors of openness to experience, conscientiousness and agreeableness (Anitei et al., 2014).

The second factor of psychoticism in Eysenck’s 3-factor theory is also concerned with one’s social interactions. This personality trait is often associated with aggressiveness, interpersonal hostility, indifference to others and other negative emotions such as selfishness and envy (Fariz et al., 2005; Barros & Silva, 2006). A low score in this factor indicates a tendency to be socially pleasant, warm, docile, altruistic, caring, loving and providing emotional support (Hutz et al., 1998).

The third factor in Eysenck's 3-factor theory is neuroticism. It must be noted that this personality factor is also present as a distinct dimension of personality in the Big 5-Factors Theory (Hutz et al., 1998). Neuroticism mainly revolves around an individual's positivity or negativity of emotions. Points between these two extremes determine an individual's emotional stability (Hutz et al., 1998; Sisto, 2004). A high score of this factor is representative of highly negative emotions such as anxiety, depression, melancholy, fear and nervousness all of which lead to emotional instability (Center, 2006). Conversely, people who score low on this factor are considered to have more positive emotions and are considered to be more emotionally stable, calm and more secure (Hutz et al., 1998; Sisto, 2004).

Over the last decade, there has been increased consensus on the robustness of the five factors, considered the best structural model available today, in describing personality (McCrae & John, 1992; McCrae, Costa, & Piedmont, 1993; Hutz et al., 1998). Considering that these 5 factors are the basic personality dimensions, it can be assumed that certain risk behaviors that individuals perform while driving may in some way relate to these factors.

Burns and Wilde (1995) examined the relationship between drivers' conduct and the drivers' personality traits. From the results, it emerged that individuals who reported higher degrees of tension and a greater propensity for risk and adventure (which the author calls "high risk personality") also exhibited these personalities in their driving behavior. Such individuals were more likely to exceed speed limits and be less careful when changing lanes. They are therefore more likely to be booked for speed violations and other traffic offenses (Burns & Wilde, 1995).

According to Alchieri and Stroeher (2002) there are certain personality traits that could pre-dispose drivers to traffic accidents. For example, various have established a link between aggressiveness and traffic accidents (Jovanovi'c et al., 2011; Herrero-Fernández, 2011; Esiyok et al., 2007; Mira, 1984). Additionally, individual characteristics such as tension, emotional instability, excitability, spontaneity and inhibition have also been linked with an increased likelihood of engaging in risk behavior (McGuire, 1972; Elander, et al., 1993). Equally, Johnson (1997) also found that driving behavior is greatly influenced by the driver's aggressiveness and irritability; and high degrees of aggressiveness and irritability are associated with a greater likelihood of traffic accidents.

In their study, Smith and Kirkham (1981) used the Maudsley Personality Inventory which evaluates the traits of extroversion and neuroticism to analyze the relationship between personality and traffic violations and accidents. They used a sample of 113 college-age drivers. The study established that there is a positive and significant correlation between extroversion and involvement in traffic accidents and with violations of traffic regulations. On the other hand, the trait of neuroticism was related to accidents only when considered together with the trait of extroversion (Smith & Kirkham, 1981).

Testing Eysenck's hypothesis that extroversion would more related to traffic accidents than introversion, Fine (1963) studied 937 university students divided into three groups: extroverts, intermediate and introverts, based on the MMPI scores. A comparison of the three groups in terms of the number of accidents resulted in a significant difference that was in alignment with the initial hypothesis. In another work, with the Japanese version of 16-PF, Pestonjee, Singh and Singh (1980) isolated the predominant personality factors in drivers. The results indicated that personality is a good predictor of healthy behavior patterns.

In addition to the personality measured by the five-factor model, Arthur and Graziano (1996) examined the relationship between scrupulosity and involvement in accidents in two samples; one of 227 university students and another of 255 employees of an agency. The results evidenced an inverse relationship between scrupulosity and involvement in accidents. The results also suggested that individuals who self-assessed themselves as self-disciplined, responsible, reliable and dependent were less involved in accidents compared to the group that reported fewer of these characteristics (Arthur & Graziano, 1996).

The personality would commit traffic offenses and accidents, but can also mediate the effects of social influences that are aimed at restricting risk behavior in driving (Iversen & Rundmö, 2002). Other studies have also established that sensation-seeking, aggression and social deviance are the traits often associated with increased likelihood of traffic accidents (Hilakivi et al., 1989, Jonas, 1997; Hall, 1997).

Otherwise, researches have established that while there is a consistent relationship between personality traits, driving behavior and accidents, this link is often weak (Cantini et al., 2015; Monteiro & Günther, 2006; Elander et al., 1993). Personality traits are considered to be weak predictors of accidents simply because there are many other factors that affect the likelihood of traffic accidents as well as the total mileage of the vehicle, time of day, weather conditions, other road users and other random factors (Ulleberg & Rundmo, 2003).

Based on this fact, personality traits can be expected to be more successful in predicting risk behavior in traffic rather to the frequency of accidents. The correlation between personality traits and risk behavior increases when a multiple-choice criterion is applied (e.g. Booth-Kewley & Vichers, 1994). It should also be noted that the same problems are elicited when studying the relationship between attitudes and specific behavior for accidents (Ajzen, 1988; Sutton, 1998). Another reason for a possibility in relation to the accident and risk behavior is that the indirect effects of personality traits are rarely studied. Theoretically, personality traits are also thought to influence an individual's perception and appreciation of the environment (McCrae & Costa, 1995).

Nonetheless, the implementation of safety programs should be taking into account personality dispositions that can result in more efficient communication of the road-safety message. Further, such programs may also help in personality traits control that can trigger behavioral changes in drivers (Ulleberg & Rundmo, 2003). But, to do it in an effective way more research about personality and driving behavior is necessary, especially about aggressiveness and anger in relation to driving behavior.

3.1. Anger

For Benfield et al. (2007), personality variables such as impulsivity, sensation seeking and risk taking are closely linked to risk-related behaviors and aggressive driving such as drunk driving and speeding. Aggressive driving has been defined in several ways over the course of research. For example, Mizell (1997) define it as a situation where an impatient or angry motorist or passenger deliberately injures or kills another road user or deliberately attempts to do so in response to a traffic dispute, or grievance. Mizell (1997) also notes that aggressive driving can involve the deliberate damage of structures and property by drivers e.g. driving a vehicle into a wall.

A more elaborate definition for drivers is that aggressive driving is any form of driver behavior that is carried out with the intent to hurt (physically or psychologically) or cause damage to other drivers (Miles & Johnson, 2003). Aggressive driving may include various forms of behavioral manifestations expressed in different manners: verbally, physically, or with a vehicle. However, it must be noted that while terms such as “road rage” are often used synonymously with aggressive driving, the former is often associated with extreme incidents of on-road violence while the latter is associated with both mild and extreme forms of aggression on the road (Parker, et al., 1998).

It is also important to note that in defining aggressive driving, one ought to single out the personality types and characteristics that are more likely to engage in aggressive behavior. This is because personality and individual attributes are extremely important in understanding and predicting aggressive behavior among drivers (Miles & Johnson, 2003).

Aggressive driving has emerged as a problem that is present in many countries of the world (Sarbesc, Stanojevic & Jovanovic, 2014). The common consensus is that aggressive driving is a major cause of many problems and disputes on the road. In fact, some researchers have strongly described it as “the most dangerous driving behavior on the roads” (Jenenkova, 2014 p. 80). Aggressive driving has been consistently linked to an increased risk of injury and even death in traffic accidents (Dorantes-Argandar & Ferrero-Berlanga, 2016).

There are two recognized general factors of aggressive driving, firstly, individual differences in age, gender, culture and personality, and secondly, environmental conditions (Sants et al., 2012). Further, environmental conditions may either be stable (such as road design and road culture) or temporary/situational such as traffic congestion, time pressure, and execution (Sinar, 1998; Sârbescu, Stanojevic & Jovanovic, 2014). Deffenbacher et al. (2003) asserts that social and environmental factors as well as the presence of hostile messages can influence anger and aggressiveness during driving. Personality and emotional disposition also seem to contribute to risky and illegal behavior among drivers (Deffenbacher et al., 1994; Deffenbacher et al., 2001; Lajunen et al., 1998; Maxwell et al., 2005; Underwood et al., 1999). Studies indicate that drivers who elicit emotions such as anger and aggression as well as traits such as risk taking, impulsivity, social irresponsibility, and sensation seeking are more likely to get involved in collisions (Deffenbacher et al., 2003).

Aggressive drivers are a risk group. In addition, they engage in more risk-augmentation behavior as well such as driving at high speeds (Maxwell et al., 2005). According to Deffenbacher et al. (2003), irritability and aggressiveness among drivers has received increased attention due to the increase in serious traffic incidents involving some form of physical aggression. The authors note that such incidents have been increasing by up to 7% per year. It estimated that between one third and two thirds of injuries is a result of aggressive driving (Deffenbacher et al., 2003).

Sârbescu et al. (2014) reported a positive relationship between aggressive driving and the severity of the accident injury. This relationship was particularly strong for young participants (16-20 years), indicating that lack of driving experience combined with aggressive driving could represent a volatile combination. In addition, the results of self-reported studies have shown connections between aggressive driving and traffic accidents (Sârbescu, et al., 2014).

There is some evidence that individual differences have an effect on aggressive driving. Gender for example has been identified as a potential predictor of possible aggressive behavior when driving (Stephens & Sullman, 2015). Indeed, studies have shown that men are more prone to aggressive driving than women (Constantinou et al., 2011; Passa et al., 2013. The specific types of cognitions that accompany aggressive driving behaviors also differ between genders. Thus, men tend to report more frequent thoughts of revenge and physical aggression than women (Deffenbacher, et al., 2003). Some of these findings should, however, be treated with caution since many of them do not provide for the fact that men are also more likely to engage in driving than women (Buraco, 2007). In the same way, some studies have shown that younger drivers report aggressive driving more often than older drivers (Perepjolkina & Renge, 2011; Jovanovic et al., 2011; Gras, et al., 2006; Lajunen & Summala, 2003).

Deffenbacher et al. (2003) note that though anger and aggression have received considerable media attention in the past decade, but other closely related factors such as irritability have been largely ignored. Yet there is evidence to suggest that factors such as irritability are much more common (Deffenbacher et al., 1994; Lajunen et al., 1998; Parker et al., 2002; Stephens& Groeger, 2009; Sullman and Stephens, 2013; Oliver, 2003; Parker, et al., 1998; Pepper, 2003; Vest, Cohen, & Tharp, 1997; Oliver 2003; Sullman, 2006; Dahlen & Ragan, 2004; Deffenbacher, Lynch, Filleti, Dahlen, & Oetting, 2003; Monteiro & Günther, 2006; Cantini et al., 2015).

Anger is one of the most studied emotions because people commonly experience it all through their lives. Anger is a relatively stable syndrome of feelings, cognition and physiological reactions, which are associated with intent to punish whoever caused the anger of the individual. Research shows that anger occurs more frequently during driving than it does during other activities (Fernández, 2013).

However, anger must be studied not only as an emotional experience, but also as a behavioral expression. The relationship between anger experience and aggressive expression is unclear (Fernández, 2013). Supposedly, drivers of vehicles that are labeled as more extroverted may be more prone to engaging in aggressive driving than drivers of supposedly introvert vehicles. It may be the case that the vehicular personality would be a projective measure of the driver's own personality (Benfield, et al., 2007).

Driving anger refers to a person's general propensity to become irritated while driving (Sullman & Stephens, 2013; Oliver, 2003). Driving anger is positively correlated with trait anxiety, more negative emotions and a less controlled expression of anger. Moreover, there is a positive correlation between driving anger and the frequency of aggression and risk behavior on the road (Deffenbacher et al., 1994; Lajunen et al., 1998; Parker et al., 2002; Stephens& Groeger, 2009; Sullman and Stephens, 2013; Oliver, 2003; Parker et al., 1998; Pepper, 2003; Vest et al., 1997; Oliver, 2003; Sullman, 2006; Dahlen & Ragan, 2004; Deffenbacher et al., 2003; Monteiro & Günther, 2006; Cantini et al., 2015).

Drivers with high levels of driving anger reported significantly more propensity to express their anger through verbal aggression, engaging in between 2.4 until 3.6 times more aggressive acts that the drivers of low anger (Deffenbacher et al., 2003). Driving frequency and total miles traveled were not highly correlated, but both related to the frequency of getting angry at the wheel and to a lesser extent, the intensity of the rage and the frequency of aggressive and risky behavior (Deffenbacher et al. 2003; Dahlen and Ragan, 2004; Deffenbacher et al., 2004; Deffenbacher et al., 2007; Esiyok et al, 2007; Moore and Dahlen, 2008; Villieux and Delhomme, 2010; Herrero-Fernández, 2011; Sullman, 2015). High anger drivers seem to have a tendency to engage in riskier behavior even when they are not angry (Deffenbacher et al., 2003).

It should be noted that the perception of driving environment is normally different for different drivers which means that different drivers may express their anger in different ways when driving due to the different environmental stimuli (Deffenbacher, et al., 2003). For example, people may be literally a few feet away from each other, but may express their driving anger toward different stimuli and in different ways. Similarly, getting out of a vehicle to have a discussion over a traffic conflict with another driver may be considered more of a physical than verbal encounter because it requires a great amount of physical aggression before words are exchanged between the parties (Deffenbacher et al., 2003).

According to Deffenbacher et al. (2003) specific measures are required to study driving anger and aggressive behavior. Such measures are not only necessary to develop a clearer theoretical and empirical understanding of the driving phenomenon, but can also be of great value in the clinical evaluation of irritated drivers, development of treatment plans and evaluation of intervention outcomes (Deffenbacher et al., 2003).

In order to assess the usual forms of drivers' anger expression in the driving context, Deffenbacher et al. (2002) developed the Driving Anger Expression Inventory (DAX). The DAX contains 49 items to classify individuals in how often they express anger. The items are divided into four sub-scales to measure the expression of anger-related driving: Verbal Aggressive Expression, Aggressive Physical Expression, which uses the vehicle for aggressive expression, and Adaptive/Constructive Expression (Deffenbacher et al., 2002).

Several studies have examined the validity of the DAX instrument (Deffenbacher et al., 2002; Villieux and Delhomme, 2010; Sarbescu, 2012; Stephens and Sullman, 2014) with many of these studies supporting its convergent validity through high and positive correlations between all aggressive forms of expressing anger, and through its negative correlations with the adaptive form of expressing anger (Dexter et al., 2004).

The DAX instrument has so far been validated in a number of other countries alongside the USA, including France (Villieux & Delhomme, 2010), Turkey (Sullman, et al., 2013) and Romania (Sârbescu, 2012). What emerged is that the original version of the DAX (49 measurement items four factors) did not completely aligned with the versions used in other studies (the closest fit was obtained in Turkey; the authors were able to fit 47 items).

Notably, with regard to the Romanian version of the DAX (Sârbescu, 2012): a three-factor structure was identified (with the Verbal and Physical Aggressive Factors attached) that obtained a good fit using a smaller version (30 items) of the original scale. The author suggested that this version (and, implicitly, the three-factor structure) might prove to be more appropriate than the original in other Eastern European countries (Sârbescu, 2012).

Iglesias, et al. (2012) proposed that generally, men tend to react more with anger and aggression during driving (especially in traffic jams) than women. Men and women also differ in how they express anger and aggressiveness (Anderson & Bushman, 2002). Thus, women tend to adopt quieter behaviors, more secret forms of aggression (such as swearing, whispered insults), while men tend to exhibit more explicit and directly observable behaviors such as obscene gestures (Galovski & Blanchard, 2004).

Deffenbacher et al. (2002) used the Driving Anger Expression Inventory (DAX) to conduct research in this direction and founded that men have significantly higher scores than women on two scales: Personal Aggressive Physical Expression (Deffenbacher et al., 2002) and Use of the Vehicle to express anger (Deffenbacher et al., 2004). In another work Aggressive Physical Expression was the only variable with significant differences between the sexes (man with the highest mean) when the effect of mileage was considered maybe because men and women express anger in driving in a different way, with men being more likely to adopt expressions of anger (such as physical aggression) than females (Iglesias et al., 2012). A possible explanation for these findings is that women tend to anticipate the potential risks and future consequences of their actions better than men do so as a self-protection mechanism, they avoid any violent behaviors that might provoke an angry reaction on their opponents (Eagly & Steffen, 1986).

Otherwise, other studies using DAX did not found significant differences between men and women in expressing their rage in traffic (Sârbescu, 2012; Herrero-Fernández, 2011; Jovanovic et al., 2011). This is in contrast with previous studies which have generally shown that males are more prone to aggressive driving behavior than females (Blanchard et al., 2000; Wiesenthal et al., 2000; Parker et al., 2002; Sinar & Compton, 2004). Considering that women are generally believed to express a higher level of responsibility, discipline and caution in traffic (Moyano-Diaz, 1997; Yagil, 1998; Manteigas, et al., 2012), it is somewhat surprising that the results regarding the differences in the expression of aggression in traffic between men and women are not consistent.

It is possible that attitudes and behaviors of men and women in traffic are becoming similar Jovanovic et al. (2011). Therefore, while women drivers may be just as prone to irritability as men, they do not always exhibit aggressive driving in response behavior. In addition, women are more likely to drive with children on board. This provides a strong incentive to drive more safely and avoid external manifestations of anger (Lonczak, et al., 2007).

In addition to that, Iglesias et al. (2012) established that age was negatively correlated with hostile gestures and the DAX subscales Verbal Aggressive Expression, Use of the Vehicle to express anger and traffic violations in both sexes. On the other hand, age positively correlated with the adaptive expression of anger. The negative correlation between anger in slow conduction and age was significant only in females and the correlation between the expression of aggressive physique and age was only significant in males. These results show that a number of differences by gender, in driving behavior, persist even if differences in mileage between the sexes are considered. As a rule, men are involved in more accidents, receiving more traffic tickets and reporting more traffic violations than women (Iglesias, 2012). These results cannot be exclusively attributed to greater exposure of men (mileage) as a driver.

3.2. Sensation Seeking

Anger and the possibility of aggression against other drivers are positively related to high Sensation Seeking (Arnett, 1990; Arnett, et al., 1997; Donovan et al., 1985; Jonah, 1997; Jonah, Thiessen, & Au-Yeung, 2001; Trimpop & Kirkcaldy, 1997). Sensation Seeking is a personality trait that can be described as the desire to engage in stimulating experiences, even at the expense of personal safety (Zuckerman, 1979). It is defined as a trait that is characterized by the search for new, complex and intense sensations and experiences and who wants to get it will take physical, social, legal and financial risks to get such sensational experiences (Zuckerman, 1994). Sensation Seeking is a temperamental predisposition for risk-taking (Silva, 2006). As a result, sensation-seekers may engage in reckless driving to provide the kind of stimulation that drivers find enjoyable (Zuckerman, 1979). Sensation seeking on the road is related to traffic accidents (Gouveia, 2010). It represents 10-15% of the variance of risk behaviors on the roads, and correlated positively with the involvement in road accident (Cestac, Paran & Delhomme, 2011).

According to Zuckerman (2007), speed is the primary objective for sensation seekers drivers, especially among younger drivers. Peer and Rosenbloom (2013) point out to the fact that speed is one of the main factors for road safety. It not only affects the severity of an accident but also the risk of being involved in an accident (Zuckerman, 1994). People usually get frustrated when they feel that their driving and speed is very low and therefore tend to select routes and speeds that will shorten the travel time as much as possible (Gouveia, et al., 2010). In some cases, increasing driving speed in order to reduce travel time may lead to exceeding the legal speed limit (Arnett, 1994). As several studies have reported, speeding behavior is often strongly related to time pressure and/or the desire to save time (Gosling et al., 2003; Delhomme, 2002; Delhomme et al., 2012). However, drivers with high Sensation Seeking (SS) also tend to engage in risky acts such as changing lanes carelessly and disregarding the required minimum spacing between cars (Nunes et al., 2010).

According to Zuckerman (2007) the risk is not what attracts sensation seekers to risk behaviors; many of these sensation seekers drivers are driven to engage in risk behavior simply because of the compensatory sensation/thrill that results from such dangerous situations. Then, the author suggests that by emphasizing the risks involved in the dangerous aggressive direction there is a greater probability that this behavior will increase rather than decrease (Zuckerman, 2007). A plausible explanation for this is that actions associated with high risks may also be more thrilling and rewarding (in terms of sensation).

To Peer and Rosenbloom (2013) the general trait of sensation seeking is composed of four components: emotion, adventure, attraction to thrill and dread. Cognitive characteristics, such as cost-benefit judgment mediate between sensation seeking and risk behaviors (Rosenbloom, 2013). The original Sensation Seeking Scale from Zuckerman uses the 40-item sensory-search scale (Zuckerman, 1979; Zuckerman, 1994). This scale is composed of four subscales: Emotion and Adventure, Experience, Disinhibition, and Boredom. In Brazil there is few adapted scale for sensation seeking (Goveia et al., 2010; Pasa, 2103, Cuffa, 2016), but no one specific to the traffic context.

Considering the greater validity of domain-specific scales to assess personality traits when focusing on specific domains, Taubman et al. (1996) developed a specific scale in the driving context named Driving Sensation Seeking Scale (DSSS). The DSSS comprises items directly related to speeding and other related to emotion, and it is positively related to risky driving and more specifically, speeding (Cestac et al., 2011).

Sensation seeking plays a considerable role in the decision-making of drivers and particularly in regards to speed (Yagil, 2001). There is a negative correlation between Sensation Seeking and time saving (Cestac et al., 2011; Nunes et al., 2010). People with high degrees of sensation seeking are more likely to choose speeds that significantly higher than people with low sensation seeking (Nunes et al., 2010). Peer and Rosenbloom (2013) are of the opinion that drivers consistently and significantly overestimated the time they could save when driving at a high speed by an average of 65%. The search for sensation showed positive correlations with the estimates of the speed required and speed of personal choice. Men chose speeds higher than women (Peer & Rosenbloom, 2013).

In Peer and Rosenbloom (2013) the main factor of the Sensation Seeking scale that correlated with the higher speed choices was the level of disinhibition of the drivers. In another study, the fact that there was no interaction between time-saving bias and Sensation Seeking points out that these two factors independently and additionally contribute to estimates of speed and choices (Cestac et al., 2011).

Age and sex have also been identified as among the strongest determinants of SS behavior. In regards to gender, men were found to have higher scores than women (Fan et al., 2014; Zuckerman & Kuhlman, 2000), and there is a decline in the search for sensations with age (Fan et al., 2014; Cestac et al., 2011). High fatality rates among young drivers who are twice as likely as older people to die in a traffic accident may be partly explained by the lack of driving experience but also by their greater likelihood of sensation seeking in driving (Cestac et al., 2011). In addition, sensation-seeking behavior has been reported to peak among drivers who are in their early to mid-teens (Merengo, Settanni & Vidotto, 2012), the sensation-seeking scores are higher among younger teens than among older teens (Fan et al., 2014). A possible explanation for this is that individuals with high levels of sensation seeking and impulsivity may start driving at an early age (Merengo et al., 2012).

Sensation Seeking trait has been found to change and evolve over time (the search for sensations) increases with age up to 16 and then declines (Hutz & Nunes, 2001). Bachoo, Bhagwanjee and Govender (2013) suggest that there are environmental and social factors that may influence the expression of Sensation Seeking for adolescents. Lamounier and Rueda (2005) as well as Gouveia et al. (2010) suggested a link between the parental control that adolescents are exposed to and the desire to seek sensations and engage in risky driving behavior. For example, there is evidence that female adolescents experience higher levels of parental control than do their male counterparts (Lamounier & Rueda, 2005). This may explain why male adolescents are more likely to engage in sensation seeking.

Smorti and Guarnieri (2014) identify other variables that may interact with Sensation-Seeking to cause traffic accidents. They include factors such as inexperience of driving, family, and personality. Compared to the most experienced drivers, young drivers do not have the experience and ability to detect and respond to hazards while controlling their vehicle and their speed (Smorti & Guarnieri, 2014). In addition, the lack of experience coupled with other factors means that young drivers are more likely to be more involved in risky driving behaviors, such as driving too fast, following too closely, overtaking in a risky way (Smorti & Guarnieri, 2014).

Rimmö and Åberg (1996) investigated the relationship between driver errors and scores on the Sensation Seeking (SS) and concluded that drivers with higher scores of SS commit more violations than those with low scores and that this relation was stronger for the Disinhibition subscale than for the Excitement and Adventure search subscales (Rimmö &

Åberg, 1996). Rimmö and Åberg (1999) concluded that the relationship between measures of SS and various risk-driving behaviors usually correlate between 0.30 and 0.40 depending on gender. Looking at the results of the researches mentioned so far, it would be logical to imagine that drivers with high SS rates would be involved in a greater number of traffic accidents. However, Jonah et al. (2001) point out that this relationship is not true. Commenting on this observation, Zuckerman (2007) hypothesizes that Sensation Seeking, may in itself, not cause accidents, instead, it combines with other personality traits as well as other factors within the driving environment to increase the likelihood of risk behavior and ultimately, the likelihood of accidents.

Smorti and Guarnieri (2014) found out that high sensation seekers drivers are impulsive, low self-control, and strongly sensitive to their inner feelings. Consequently, they look for environments which offer them stimuli that can maximize the satisfaction of their need for excitement. Sensation seekers also tend to underestimate the health and physical risks associated with engaging in dangerous behaviors. In sum, the search for sensations motivates individuals to engage in behaviors that are risky and therefore exciting for them (Hutz & Nunes, 2001). People with less desires to seek sensations also demonstrate relatively less driver anger (Lamounier & Rueda, 2005).

4. Overview of the Research Program and Hypotheses

Because of the high costs with hospitals and health problems, and because of the social costs, Brazilian traffic accidents appear as one of the main problems to be solved to improve the country quality of life (WHO, 2015). To solve this problem a very difficult equation should be resolved, the dependent variable is accident. The independent variables are known: the road, the car and the human being. The main question is about the values of the variables in the equation. About roads, engineers have an answer; about cars, they are the most widely used form of transportation in Brazil (Vasconcellos, 2000; 2001, Chapman, 2007; Metz, 2012) and they are not very safe, because Brazilian regulations and the deferential approach of automobile manufacturers. About human beings there are several components to this variable: personality and emotional states as aggressiveness and anger are between the most important ones. However, there are few studies looking for ways to solve the equation and efficient strategies to mitigate the problems. Recognize that the gap between car accidents and prevention/intervention programs is efficient research it is an important step to more effective practices. This can bring multiple benefits such as the cost reduction for the government, better quality of life for the general population and save of time, but it is important that the Brazilian government try to launch and promote it, it is a topic that is in debate since 2000, but still was not implemented (Brasil, 2015).

Traffic Psychology has studied different models to understand and help to decrease car accidents. Several studies have focused in different ways, as driver behaviours, driver personality factors, emotional states and the interaction with the environment (Costa, 2003; Oliveira & Pinheiro, 2007; Pirito, 2005). Also, Social and Cognitive Psychology could contribute with additional considerations to a fuller understanding of the promotion of safety

(Balbinota et al., 2011). Hence, integrate perspectives implies to explore the subjective position of the accidents, the drivers, with their personal and social evaluations, their representations, their psychological motivations, and their psychological barriers. This psychosocial approach has not been really fully considered before in the promotion of safe driving in Brazil (Cantini et al., 2015).

In this PhD thesis, the focus is to study the role of aggressiveness in road traffic in Brazil and to examine how eco-driving behavior can contribute to dealing with aggressiveness aim to improve road safety and mobility. Driving is structured in a multiple specific context: the road, the rules, the interactions and decisions, which can be the difference between an accident or not, between life and death. This context includes specific conditions around drivers including physical environmental conditions (e.g. cities with good or bad road conditions, temperature, signaling), contextual situations (e.g. being in a hurry, being in a traffic jam), traffic engineer (e.g. the green wave effect, speed cameras control), social dimensions (e.g. interaction with the people around, pressure). However, driving is also influenced by personality characteristics (e.g. became angry easily, how to react in different situations, how to accept the rules) as well as other psychological factors (e.g. representations, motivations, perceptions, sensations). Some types of personality tend to be more involved in accidents than others (Sullman & Stephens, 2013).

In Brazil, drivers do not know, in general, how to drive in a safety and economic way, it means that road users could find more difficulties to make a decision different from the social norm (i.e. drive in a constant speed as much as possible) than a decision that corresponds to the social norm (i.e. quickly speed up and down). Indeed, one of the processes associated with a future behavior; in this case, driving is related to the social image and the representations of driving. A potential driver could feel that driving in the constant speed means going against the current, which is negative. However, he or she could also feel that it means going through a challenge, and this feeling could be experienced as positive (e.g. pursuit a goal, or for sensation seeking).

Another process is related to the Hostility (Bolson, Beck & Rodrigues, 2010). This process is a subjective and personality aspect of the drivers, in particular, the personal internal way to react in a social context to other people. This subjective evaluation will differ between the drivers' backgrounds and depends on personal context. There is a subtle but important aspect between the way of a driver's reaction in social context and the way which decide something.

Thus, the social context could influence the subjective evaluation of a situation, particularly interpretation of the perceived information (Rueda, 2009). In conflictual interaction, car drivers could feel that the other is acting against them (Rubin, 2013), and even interpret the other's behavior as aggressive, turning the situation into a conflict or not understanding a sign to get involved into an accident, or processing wrongly the information and making a serious mistake (Almeida, 2015). This perception of car drivers' behaviors as aggressive could also happen even when these behaviors are not necessarily intended to cause any harm (Baron & Richardson, 1994).

To summarize, remaining issues concerning the car driver´s accidents are the comparison of the different aspects of the drivers (individual differences, personality and emotional states) that are relating to driving behavior. To study the influence of drivers of psychological factors, such as the personality, cognitive aspects and barriers to change the behaviours, and the perception of the car drivers, in terms of perceived aggression and risk of accidents, is essential to better understand the safety/risky phenomena and change it. In addition, this knowledge is especially important to help design actions aimed to promoting eco-driving as a way of driving, and improving road safety. The consequence is a better quality of the drivers' lives because they are avoiding accidents, diminishing stress in traffic, saving money and protecting the environment. In this Ph.D. thesis, these issues were addressed developing three studies with three samples who differed in particular in terms of age (young vs. older drivers) and in terms of gender. Moreover, these samples were composed of students in one study, of traffic offenders on retraining courses to regain the right to drive in the other study, and of professional drivers in the last study.

In the first study, the aim was to validate the Brazilian adaptation (DAX-BR) from Driving Anger Expression Inventory (DAX, created by Deffenbacher, Lynch et al., 2002) among young university drivers. We tested the psychometric properties of this adaptation and its factorial structure as well as we examined its relationships with personality traits and traffic violations. This study was a first step in the understanding of drivers aggressively behaviors and the correlations with personality traits.

We followed the procedure used by Villieux and Delhomme (2010) who adapted the DAX scale in French, that is to say we tested the DAX factorial structure and the reliability of its factors and examined its relationships with 1) different types of transgressions and errors committed while driving registered by Driving Behavior Questionnaire (DBQ, Reason et al., 1990; validated in Brazil by Bianchi & Summala, 2002), as well as traffic accidents and 2) other personality factors such as the Driving-related Sensation-Seeking Scale (DSSS, Taubman et al., 1996), and the Hostility Scale (Rolland & Petot, 1994).

The participants were undergraduate students that filled in a questionnaire during the classes. They were asked to answer questions only if they have their driving license. This questionnaire registered the first adaptation of DAX to Brazilian context, Driving-Sensation-Seeking Scale (DSSS), the Hostility Scale, and the DBQ, as well as socio-demographic data such as age, gender, driving experience in terms of diving license, kilometers driven per year, of accidents and fines in the last 5 years and preferences by speed on different roads.

The first hypothesis was based on knowledge and postulated that the younger drivers tend to be more aggressive, try to search more sensation and be more hostility than older drivers. In addition, that should be more involved in car accidents and received more traffic fines and that men should be more aggressive than women.

A second study was conducted to provide further validity of the DAX-BR in a distinct and larger population of the city of Curitiba. This second study was focused on a population of drivers on retraining courses to regain the right to drive because they used to be more aggressive since they had committed many violations and received several traffic fines. This second study had two aims. The first aim of this study was to test if the first DAX-BR structure scale works out in a different type of sample and the second aim was to know how personal and personality traits work with more aggressive sample drivers.

In this study, participants were drivers enrolled in a course to regain the right to drive. They were older than the first sample and had more driving experience. The course was in the State Department of Traffic. All of the drivers there were invited to participate received the guarantee of confidentiality and they have the option to not participate in the research and there was no problem about it. The instruments were the same of first study.

The second hypothesis to be tested is that the sample of second studied will have higher aggressively results than the first sample. Because this population comes from refresher course to regain the possibility of the right to drive cars and that the DAX-BR factorial structure of first study should apply for this population.

Eco-driving style is based on anticipation, that means having a large headway and adopt smooth acceleration and smooth deceleration, so the driver is calm, less stressful and he or she can react in a less aggressive way. Also, eco-driving style is a more silent way to drive and, also, it is a good strategy to mitigate sound pollution.

The idea of the third study was to reduce the impact of aggressiveness on the drivers' behaviours in leading drivers to practice eco-driving. This was because when training is effective for drivers, it ends up bringing their automatons behaviors in traffic resulting in personal gains as well as to the environment (Bastos, 2011; Andrieu & Saint-Pierre, 2012).

In a test performed by Edmunds (2005), moderate driving yielded, on average, 31% better mileage than aggressive driving. LeBlanc et al. (2010) found, in a naturalistic driving study that, for both speed keeping and accelerating from rest, drivers using the same vehicle differed by about 20%, although some of that variation is expected to result from factors other than the degree of aggressive driving.

If a driver has a deviation from the anticipated situation and therefore the habitual behavior, he or she tends to take action to avoid negative consequences (Summala, 2007; Saad, 2002). The action could shift the goals and take further regulatory actions based on the mental representations of the situation in order to maintain control over their vehicle and preferably return to a more typical automated effortless driving style (cf. Brehmer, 1992). It could mean to return to certain aggressive behaviors such quickly breaks and quickly accelerations.

Participants in the third study were professional drivers from a manutention company in the city of Curitiba. They were designed to two groups: experimental and control. We had used a before-after design. In the experimental group (vs. the control group), an eco-driving training was launched. The hypothesis was that that the group of drivers who received an eco-driving training would have a better result in reducing fuel consumption when compared to drivers who did not train to drive and behave in this way. The last hypothesis is about connection between anger or aggressiveness and driving behavior, the group that received eco-driving training could control aggressiveness behavior in driving changing driving style as for example, do not accelerate or deceleration abruptly, or maintaining a constant speed on the road as much as possible.

The development of this thesis will allow the resumption and, as well as the debate of the hypotheses raised, allowing the evolution and continuity of the aspects inherent to the human being, whether in its dimension of the preservation of life, or in its ability to move.

PART II: EMPIRICAL RESEARCH

5. The first Study: Adaptation of DAX to a Brazilian Students Sample

5.1 Introduction

Crash risk while driving is an important concern for modern societies where road accidents represent a great public health problem, incurring, also, immaterial loses (Smori & Guarnieri, 2014; Bartholomeu, 2008). In Brazil, the number of road fatalities and serious injuries exceeds 150,000 per year, with a population of 200 million people according. Applied Economic Research Institute (IPEA, 2016) estimates total costs of accidents in Brazil are R$ 28 billion per year. Since 2008, in Brazil, the road accident numbers increased by 19%, while the population in the country increased by 17%. In the same period, the hospital stays by traffic accidents increased by 9% (Bacchieri & Barros, 2011). Brazil witnessed in 2015 (WHO) numbered over 40,000 dead and 204,000 injured, and the total number of 2.1 million traffic accidents, fatality rate 23.1 deaths of 100.000 inhabitants being at least twice as large they found in developed countries (Brazil, 2014).

Teenagers and young adults are known for their high involvement in risky behaviors compared to other age groups (Arnett, 1996). Novice and beginner drivers are over represented in car accidents with more than 115.000 deaths (WHO, 2017) in spite of the great progress achieved in understanding their behavior and of the countermeasures (Rivis, et al., 2011; Scott-Parker, et al., 2009).

Risky driving behavior and high sensation seeking are positively related to traffic accidents, speeding, anger, disrespect for laws, and the possibility of aggression against other drivers (Arnett, 1990; Arnett, et al., 1997; Donovan, et al., 1985; Jonah, 1997; Jonah, Thiessen, & Au-Yeung, 2001; Trimpop & Kirkcaldy, 1997). Sensation seeking is a personality trait that describes the tendency to seek out varied, complex and intense new sensations and experiences, and the willingness to take risks in order to satisfy such experiences (Zuckerman, 1979). High levels of either sensation seeking or anger increase the likelihood of several risky driving behaviors, such as increased speed and behaviors that may cause an accident, such as a hasty maneuver (Delhomme, Chaurand & Paran, 2012). Given the greater validity of the specific domain scales to assess personality traits when focusing on specific areas, Taubman, et al. (1996) developed a specific range in the driving context named Driving Sensation Seeking Scale (DSSS) (adapted in English by Yagil, 2001 and in French by Delhomme, 2002). The DSSS comprises 7 items directly related to speeding and other related emotion and was positively related to risky driving (Delhomme, Verlhiac & Martha, 2009).

There is a close positive relationship, in particular in Brazil, between risk behavior, sensation seeking and hostility (Andrade et al., 2003; Cuffa, 2016, Smorti & Guarnieri, 2014). Several risk behaviors were observed among Brazilian university students, especially with men, who tend to exceed speed limits further and disregard other traffic safety rules, such as the use of seat belts, drunk and driving, making dangerous overtaking, which it can increase the probability of accidents (Yamada, 2005).

In this context, accidents of angry young drivers had been become increasingly common (Oliver, 2003; Parker, et al., 1998; Pepper, 2003; Vest, et al., 1997; Oliver 2003; Sullman, 2006; Dahlen & Ragan, 2004; Deffenbacher, Lynch, Filleti, Dahlen & Oetting, 2003).

The latter situation necessarily involves behaviors in which the driver does not intend to harm other road users and may not be aware of what risks are involved (Bartholomeu, 2008). This driving behavior is aggressive in appearance but does not necessarily imply intent to cause damage, although it may subsequently put other road users at risk (Vallières, Bergeron & Vallerand, 2005).

Aggressive behavior has multiple settings. It can be expressed by the motor, via attacks of movement or leakage; by emotional or via ahead hostility to another person trying to express control over other (Fariz, et al., 2005; Barros & Silva, 2006). The hostility is something that takes the driver often to commit violations of rules and causing traffic accidents (Villieux & Delhomme, 2008). Among these emotional factors, anger reflects a predisposition to experience anger more frequently while driving. So, anger refers to the propensity to become angry while driving (Deffenbacher et al., 2003). Driving anger could be considered an important factor in the prediction of risky behavior on the road, compared with other personality factors such as sensation seeking, impulsivity and hostility (Dahlen, Martin, Ragan & Kuhlman, 2005; Villieux & Delhomme, 2010). Driving anger can generate risk behavior, in particular for young drivers and that may contribute to explaining their involvement in more road accidents.

In young drivers aggressive behavior is positively associated with disrespect the rules of traffic, increase speed, increase the possibility of aggression with other drivers (Andrade et al., 2003). Emotional factors of young drivers, such as aggressiveness or angry, are direct cause and negatively affect their ability to process information relevant to driving (Bartholomeu, 2008). To Kontogiannis (2006) assets accidents (hit another vehicle) are more related to young drivers as passive accidents (being hit by another vehicle) are more correlated with older drivers (Kontogiannis et al., 2002).

To measure trait-driving anger and the anger experienced by drivers in potentially anger-provoking situations, Deffenbacher et al. (1994) developed the Driver Anger Scale (DAS). If anger may influence emotional and behavioral reactions differently for two people in the same situation, the way it handles this person and express their reaction should be taken into account. That is why Deffenbacher, Lynch, et al. (2002) have conceptually separated driving anger from the manner of its expression and developed the Driving Anger Expression Inventory (DAX) (Deffenbacher, Lynch, et al., 2002). In Brazil, there are few studies about driving anger which is an important topic (Monteiro & Günther, 2006; Cantini et al., 2015), and there is not adaptation of DAX.

The DAX is a 49-item scale divided into the following four sub-scales (or factors): 'Verbal Aggressive Expression' (12 items); 'Personal Physical Aggressive Expression' (11 items); 'Use of the Vehicle to Express Anger' (11 items); and 'Adaptive/Constructive Expression' (15 items). The DAX has been applied in drivers from several different countries as England (Stephens & Sullman, 2014), France (Villieux & Delhomme, 2010), Romania (Sarbescu, 2012), Serbia (Jovanovi'c et al., 2011), Spain (Herrero-Fernández, 2011), Turkey (Esiyok et al., 2007) and the USA (Deffenbacher et al., 2002). Some researchers have reduced the number of the original model factors. For example, Sarbescu (2012) reported a three-factor model with 30 items, which combined verbal aggression and physical on a single factor. Villieux and Delhomme (2010) reported a three-factor solution using only 11 of the 49 original items. However, some research had used the four-factor model, but only achieved acceptable results after a few case adjustments (Sullman et al., 2013).

Studies, using the DAX conducted in the United States, show that the three aggressive forms of expression ('Verbal Aggressive Expression,' 'Personal Physical Aggressive Expression' and 'Use of the Vehicle to Express Anger') correlate positively with traits driving anger, aggression, and risky behavior, whereas 'Adaptive/Constructive Expression' correlates negatively with these variables (Deffenbacher, Lynch, Deffenbacher & Oetting, 2001; Deffenbacher, Lynch et al., 2002).

These relationships between driving anger and risky behavior were found not only in the United States but also in Great Britain (Lajunen et al., 1998; Underwood, Chapman, Wright, & Crundall, 1999; Lajunen & Parker, 2001); France (Delhomme & Villieux, 2005, 2008; Villieux & Delhomme, 2007, 2008), New Zealand (Sullman, 2006); Norway (Iversen & Rundmo, 2002); Romania (Sârbescu, 2012), Serbian (Javanovic et al., 2011) and Spain (Sullman, Gras et al., 2007). Jovanovic et al. (2012) found that DAX aggressive behavior is highly positively correlated with the number of traffic accidents. Nesbit et al. (2007) and Gonzalez-Iglesias et al. (2012), using the DAX, found a positive relationship between anger and various risky driving behaviors including traffic tickets, speeding and flashing light. In addition, traffic violations also closely positively related to the expression of anger and aggression (Gonzalez-Iglesias et al., 2012).

To examine the behavioral issues of the risk behavior in the traffic, often the Driver Behaviour Questionnaire (DBQ, Reason, et al., 1990) is used (Oliveira, 2008). There is a positive correlation between anger while driving and behaviors from DBQ (Baron & Richardson, 1994; Berkowitz, 1993; Coie & Dodge, 2000; Jovanovic' et al., 2011). The DBQ version of 28 questions from Lawton et al. (1997) has four factors with errors, aggressive or ordinary violations, and lapses. This version from Lawton et al. (1997) was adapted in Brazil by Bianchi and Summala (2002) and used by Maoski, (2014) and Rezende (2015). From the original instrument, seven items did not fit into the original DBQ structure and two items had no satisfactory factorial load and were excluded. In this structure, the DBQ-BR presented a general Cronbach's alpha of 0.84.

The aims of this study (Olandoski, Bianchi & Delhomme, 2017) were to provide a Brazilian adaptation of a Driving Anger Expression Inventory (DAX) (Deffenbacher, Lynch et al., 2002), testing its psychometrics properties and investigating its relationships with risky behaviors (DBQ), accidents, fines, driving sensation seeking and hostility.

5.2 Method

5.2.1 Participants

The sample was composed of 512 undergraduate driver volunteers (52.1% men) surveyed at the universities of Curitiba. The mean age of participants was 23.70 years (SD=5.74, range=18 to 40) and 81.7% were until 25 years old. They had their driver's license from one month to 20 years (M=5.00 years, SD=3.39) and reported driving an average of 11400 kilometers per year (SD=8200, range=1000 to 30000) since receiving their drivers' license.

Road accidents were divided into active accidents (when the driver causes an accident) and passive accidents (when the driver is involuntarily involved in an accident). Regarding active accidents with only damage over the past five years, 20.1% of participants reported having been involved in a car accident with minor damage once, 5.1% twice and 1.4% three times; 3% of participants reported having been involved in a car accident with small damage suffered once and 0.5% twice, and 0.6% of participants reported having been involved in a car accident with great damage once and 0.4% twice. Regarding passive accidents with minor damage over the past five years, 18.9% of the sample reported having been involved in a car accident with minor damage once, 5% twice and 1.1% three times; 2% of the sample reported having been involved in a car accident with small damage suffered once and 0.4% twice, and 0.8% of the sample experienced a time a car accident with great damage.

For a better understand which factor is a significant predictor of accidents, they were transformed into a dependable binary variable. In the sample, 27% of participants had done an active accident and 26.4% had suffered a passive accident.

Regarding the fines, 10.4% of participants reported having received one fine for exceeding the speed limit, 4.7% received two penalties, 3.7% three penalties, 1% received four fines and 1.4% received five fines; 5.1% of participants reported having already been ticketed once for running a red light, 2% twice, 1.2% three times and 0.1% four times. For driving and talking on the cell phone, 4.9% of participants have received a fine, 1.2% received two fines and 1% received one fines.

Moreover, 10.4% of participants reported that they received a parking ticket, 4.9% received two fines, 2% received three fines; 3.5% have received a fine for stopping in the crosswalk, and 1% has already received a fine for driving drunk. Finally, 1.6% of participants reported that they received another type of penalty such as making a prohibited conversion, driving in the wrong way and stopping in the crosswalk. For a better understand which factor is a significant predictor of fines, they were transformed into a dependable binary variable. In the sample, 65.3% of participants reported having never received a fine while 36.5% having received at least a fine.

5.2.2 Measures

(1) The adaptation of the Driving Anger Expression Inventory (DAX; Deffenbacher, Lynch et al., 2002) to Portuguese was done using a back translation process. After translation from English to Portuguese by a native speaker of both languages and that understood the sense context to local reality, a second bilingual person did the back translation, and a third bilingual person check and compared the translation of the original scale. Participants rated items on a 4-point scale (1=‘almost never’ to 4=‘almost always’) according to the degree to which they express their anger while driving in the manner described in the item.

(2) The Brazilian adaptation of the unifactorial Hostility scale (Rolland & Petot, 1994) to Portuguese was done using a back translation process. After translation from English to Portuguese by a native speaker of both languages and that understood the sense context to local reality, a second bilingual person did the back translation, and a third bilingual person check and compared the translation of the original scale. The scale has 8 items rated on a 5-point scale (1=‘not at all’ to 5=‘very much’) according to the amount of experienced when encountering the situation described. The alpha was 0.61 close to Delhomme and Villieux (2008).

(3) The 28 items Driver Behaviour Questionnaire –DBQ (Reason et al., 1990) adapted to use in Brazil by Bianchi and Summala (2002) divided into four factors: Errors, Aggressive Violations, Ordinary Violations and Lapses with a range rated items on a 6-point scale (0 = 'never' to 5 = 'always'). It was used errors, Ordinary Violations and Aggressive Violation factors in this study. At the end of DBQ, two new questions referring to Aggressive Violations factor were included: "Driving too close to the car in front with the intention to go faster or get out of his way" and "Getting angry at a certain type of driver and show it.” Then, the final DBQ was a 30-item questionnaire.

(4) The unifactorial Driving Sensation Seeking Scale - DSSS (Taubman, et al., 1996) adapted to Portuguese was done using a back translation process. After translation from English to Portuguese by a native speaker of both languages and that understood the sense context to local reality, a second bilingual person did the back translation, and a third bilingual person check and compared the translation of the original scale. The scale contains 7 items rated items on a 4-point scale (1= "never” to 4 = “always”). The alpha of the scale was .0.86 this was higher than Delhomme, Chaurand and Paran (2012).

(5) Socio-demographic variables were registered on age, gender, kilometers driven since receiving a driver's license and the year of license, types of accidents as a driver and number of fines received in the last five years, as well as the maximum speed that drivers drive on various road types: main roads, on dual carriageways, in town centers and country roads (Delhomme, Cristea & Paran, 2014).

5.2.3 Procedure

Survey participants completed the five measures in a single section. The measures were presented in this sequence: DAX-BR, Hostility scale, DBQ, DSSS and, the socio-demographic questionnaire. The study presented various aspects of driving behavior with the goal of better understanding the driver’s habits. Also, it was assured that the answers would be treated with strict confidentiality and anonymity attending ethical procedures. The entire process took less than 20 minutes to complete.

5.3 Results

The findings are reported in five parts. The first part is focused on the DAX-BR. We expose the descriptive statistics (means and standard deviations) then for the internal structure analysis of DAX-BR, and an exploratory factorial analysis (AFE). First, the factor of the 49 original items that composes the DAX-BR Scale was checked using the Kaiser-Meyer-Olkin criterion (KMO) (Field, 2009). Afterwards, we examined the internal consistency of DAX-BR factors assessed using the Cronbach’s alpha coefficient. Comparisons among groups on accidents, gender and fines are conducted for each factor of the DAX-BR presents the results of the confirmatory factor analysis (CFA) to examine its factorial structure.

The CFA was performed over the variance covariance matrix using the AMOS statistical package, the goodness-of-fit for the model was assessed using the chi-square statistic, the Index (GFI), the Adjusted Goodness of Fit Index (AGFI), the Incremental Fit Index (IFI), the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA).

The second part of results is focused on the DBQ, the third one is focused on Hostility scale and DSSS. The fourth part presents correlations between all variables used in this study before exposing in the fifth last part, the predictors of the violation types. To elucidate if DAX-BR factors are significant predictors, linear and binary regressions were performed.

5.3.1 DAX-BR - Factor Analysis of Driving Anger Expression Inventory

5.3.1.1 Descriptive analysis

Descriptive analysis Means and standard deviations for all DAX-BR items are presented in Table 1.

Table 1: DAX-BR items.

DAX-BR items*	M	SD
1. I give the other driver the finger.	1.09	0.32
2. I drive right up on the other driver's bumper.	1.45	0.64
3. I drive a little faster than I was.	2.21	0.85
4. I try to cut in front of the other driver.	1.44	0.71
5. I call the other driver names aloud.	1.70	0.93
6. I make negative comments about the other driver aloud.	2.42	0.96
7. I follow right behind the other driver for a long time.	1.31	0.65

8. I try to get out of the car and tell the other driver off.	1.02	0.18
9. I yell questions like 'Where did you get your license?'	1.29	0.65
10. I roll down the window to help communicate my anger.	1.10	0.36
11. I glare at the other driver.	1.70	0.86
12. I shake my fist at the other driver.	1.05	0.27
13. I stick my tongue out at the other driver.	1.05	0.30
14. I call the other driver names under my breath.	2.29	1.02
15. I speed up to frustrate the other driver.	1.40	0.72
16. I purposely block the other driver from doing what he/she wants to do.	1.35	0.66
17. I bump the other driver's bumper with mine.	1.04	0.06
18. I go crazy behind the wheel.	1.31	0.67
19. I leave my brights on in the other driver's rear view mirror.	1.32	0.67
20. I try to force the other driver to the side of the road.	1.04	0.23
21. I try to scare the other driver.	1.06	0.30
22. I do to other drivers what they did to me.	1.25	0.54
23. I pay even closer attention to being a safe driver.	2.81	0.93
24. I think about things that distract me from thinking about the other driver.	2.13	0.92
25. I think things through before I respond.	2.66	0.97
26. I try to think of positive solutions to deal with the situation.	2.49	0.98
27. I drive a lot faster than I was.	1.72	0.86
28. I swear at the other driver aloud.	1.58	0.96
29. I tell myself it's not worth getting all mad about.	2.51	1.02
30. I decide not to stoop to their level.	2.61	1.06
31. I swear at the other driver under my breath.	2.35	1.00
32. I turn on the radio or music to calm down.	2.53	1.06
33. I flash my lights at the other driver.	1.42	0.79
34. I make hostile gestures other than giving the finger.	1.19	0.55
35. I try to think of positive things to do.	2.30	0.96
36. I tell myself it's not worth getting involved in.	2.72	1.03
37. I shake my head at the other driver.	2.40	1.00
38. I yell at the other driver.	1.24	0.58
39. I make negative comments about the other driver under my breath.	2.30	0.95
40. I give the other driver a dirty look.	2.15	0.98
41. I try to get out of the car and have a physical fight with the other driver.	1.04	0.29
42. I just try to accept that there are bad drivers on the road.	2.68	0.96
43. I think things like 'Where did you get your license?'	2.10	1.06
44. I do things like take deep breaths to calm down.	2.54	0.96
45. I just try to accept that there are frustrating situations while driving.	2.63	0.94
46. I slow down to frustrate the other driver.	1.42	0.78
47. I think about things that distract me from the frustration on the road.	2.25	0.94
48. I tell myself to ignore it.	2.56	0.95
49. I pay even closer attention to other's driving to avoid accidents.	3.12	0.92

* 4-point scale (1='almost never' to 4='almost always')

The Kaiser-Meyer-Olkin (KMO) measure (0.87) and Bartlett`s test of Sphericity ($p<0.001$) were calculated indicating that data are appropriate to perform principal axis analysis with an oblimin rotation. To test the original four factors model in Brazil, a four-factor extraction was attempted. Together the four factors accounted for 37.56% of the total amount of variance. Inclusion item criteria were set up at 0.30, items with a factorial load below 0.30 were excluded, and then six items were deleted (items 7, 8, 12, 13, 17 and 41).

A second extraction was performed using the oblimin rotation on the 43 remaining items. The four factors accounted for 42.20% of the total amount of variance. The first factor explained 19.90% of the variance, the second factor explained 12.87%, the third explained 5.35% and the last one explained 4.08%. Table 2 shows the factor load of each item into the four DAX-BR factors.

Table 2: DAX-BR items per Factors.

DAX-BR items/factors Adaptive/Constructive Expression (F1)	F1	F2	F3	F4
49. I pay even closer attention to other's driving to avoid accidents.	**0 .628**	0.101	-0.046	-0.002
23. I pay even closer attention to being a safe driver.	**0.487**	0.013	-0.001	0.056
36. I tell myself it's not worth getting involved in.	**0.778**	-0.123	-0.113	0.006
42. I just try to accept that there are bad drivers on the road.	**0.5**	0.006	-0.111	0.052
25. I think things through before I respond.	**0.601**	-0.211	-0.079	-0;167
45. I just try to accept that there are frustrating situations while driving.	**0.674**	-0.061	-0.023	0.036
30. I decide not to stoop to their level.	**0.638**	-0.125	-0.06	-0.07
48. I tell myself to ignore it.	**0.775**	0.025	-0.115	-0.049
44. I do things like take deep breaths to calm down.	**0.705**	0.079	-0.036	0.112
32. I turn on the radio or music to calm down.	**0.455**	0.05	0.144	0.207
29. I tell myself it's not worth getting all mad about.	**0.696**	-0.081	-0.031	-0.143
26. I try to think of positive solutions to deal with the situation.	**0.684**	-0.132	-0.08	-0.263
35. I try to think of positive things to do.	**0.767**	-0.033	0.005	-0.094
47. I think about things that distract me from the frustration on the road.	**0.746**	0.017	-0.039	-0.019
24. I think about things that distract me from thinking about the other driver.	**0.467**	-0.063	0.035	-0.048
Personal Physical Aggressive Expression (F2)	**F1**	**F2**	**F3**	**F4**
18. I go crazy behind the wheel.	-0.073	**0.381**	0.245	0.157
34. I make hostile gestures other than giving the finger.	0.049	**0.588**	0.219	0.054
10. I roll down the window to help communicate my anger.	-0.055	**0.398**	0.261	0.042

1. I give the other driver the finger.	-0.113	**0.582**	0.048	0.129
21. I try to scare the other driver.	-0.068	**0.614**	0.114	-0.038
20. I try to force the other driver to the side of the road.	-0.021	**0.362**	0.046	-0.113
Use of the Vehicle to Express Anger (F3)	**F1**	**F2**	**F3**	**F4**
3. I drive a little faster than I was.	-0.108	-0.044	**0.618**	0.292
27. I drive a lot faster than I was.	-0.002	0.072	**0.664**	0.156
2. I drive right up on the other driver's bumper.	-0.052	-0.004	**0.485**	0.091
4. I try to cut in front of the other driver.	0.216	-0.128	**0.556**	-0.201
33. I flash my lights at the other driver.	0.011	0.221	**0.461**	-0.01
46. I slow down to frustrate the other driver.	0.011	0.259	**0.375**	-0.031
15. I speed up to frustrate the other driver.	-0.139	0.167	**0.671**	0.132
16. I purposely block the other driver from doing what he/she wants to do.	-0.112	0.285	**0.541**	0.047
19. I leave my brights on in the other driver's rear view mirror.	0.288	-0.079	**0.492**	-0.031
22. I do to other drivers what they did to me.	0.251	-0.05	**0.452**	-0.101
3. I drive a little faster than I was.	-0.108	-0.044	**0.618**	0.292
Verbal Aggressive Expression (F4)	**F1**	**F2**	**F3**	**F4**
6. I make negative comments about the other driver aloud.	-0.153	0.253	0.121	**0.55**
37. I shake my head at the other driver.	0.021	0.243	0.16	**0.497**
31. I swear at the other driver under my breath.	-0.019	0.007	0.091	**0.758**
39. I make negative comments about the other driver under my breath.	-0.006	0.162	0.12	**0.716**
14. I call the other driver names under my breath.	-0.009	0.084	0.107	**0.752**
40. I give the other driver a dirty look.	-0.027	0.257	0.219	**0.531**
43. I think things like 'Where did you get your license?'	0.1	0.204	0.033	**0.359**
5. I call the other driver names aloud.	-0.183	0.205	0.084	**0.541**
11. I glare at the other driver.	-0.098	0.214	0.277	**0.393**
28. I swear at the other driver aloud.	-0.182	0.164	0.295	**0.623**
9. I yell questions like 'Where did you get your license?'	-0.059	-0.008	0.238	**0.579**
38. I yell at the other driver.	-0.163	0.154	0.15	**0.694**

5.3.2 Confirmatory Factor Analysis

Responses to the items of the DAX-BR were subjected as the original (Deffenbacher, Lynch et al., 2002) structure to Confirmatory Factor Analysis (CFA) using the maximum likelihood method. Results indicated that this model obtained a reasonable fit index: $X^2(1033) = 2058.65$ pb.001; $\chi 2/$ 2058.65=2.00; GFI=.86; AGFI=.84; IFI=.88; CFI=.87; TLI=.86; RMSEA=.044. Usually, a non-significant chi square and values greater than .85 for the GFI, AGFI, IFI, CFI, and TLI are considered to reflect an acceptable model fit. In addition, an RMSEA value of less than .05 indicates close fit and values up to .08 indicate reasonable errors of approximation (Villieux & Delhomme, 2008).

5.3.3 Internal Consistency

The internal consistency was tested using Cronbach's alpha. The DAX-BR version has satisfactory reliability scores for the total scale (α=.83) and for each of the four factors (α's ranging from .69 to .88). In the Table 3 are presented descriptive statistics and Cronbach's alphas to DAX-BR's factors.

Table 3**: Means, SD and alphas to DAX's-BR Factors**

DAX-BR factors*	M	SD	Cronbach's alpha
Adaptive/Constructive Expression	2.57	0.63	0.88
Verbal Aggressive Expression	1.96	0.56	0.85
Use of the Vehicle to Express Anger	1.48	0.41	0.78
Personal Physical Aggressive Expression	1.09	1.55	0.69

* 4-point scale (1='almost never' to 4='almost always')

The 'Adaptive/Constructive Expression' factor had the highest rating (M=2.57), with item 49 'I pay even closer attention to other's driving to avoid accidents' having the highest mean observed (M=3.12). Items in the 'Personal Physical Aggressive Expression' factor had lower mean ratings (M=1.09), with item 17 'I bump the other driver's bumper with mine' obtaining the lowest means of all the items (M=1.04).

5.3.4 Results on Group Differences for DAX-BR's Factors

A one-way between subjects ANOVA was conducted to compare the differences between groups by passive and active accidents, gender and fines on DAX-BR factors. The total participants in each group of active accidents (to have = 139 drivers or not to have = 373 drivers), about passive accidents (to have =135 drivers or not to have = 377 drivers), gender (male = 265; female = 245) and about fines (to have = 187 drivers or not to have = 325 drivers).

There was a significant difference means between groups of gender in adaptive/Constructive Expression factor ($F_{(1, 509)} = 26.20$, $p<0.01$) (Male=2.44, Female=2.72). For another three DAX-BR's factors there weren´t significant means differences.

For the active accidents (to have or not to have) there were significant means group differences in adaptive/Constructive Expression factor ($F_{(1, 509)} = 4.11$, $p<0.05$; to have=2.60, not to have=2.48), Use of the Vehicle to Express Anger ($F_{(1, 506)} = 14.76$, $p<0.01$; to have=1.59, not to have=1.44), Personal Physical Aggressive Expression ($F_{(1, 506)} = 13.63$, $p<0.01$; to have=1.13, not to have=1.07), and the Verbal Aggressive Expression ($F_{(1, 507)} = 11.88$, $p<0.01$; to have=1.91, not to have=2.10).

To involvement in passive accidents there were significant means differences between groups for Verbal Aggressive Expression factor ($F_{(1, 507)} = 9.05$, $p<0.05$; to have=2.09, not to have=1.91) and for Use of the Vehicle to Express Anger ($F_{(1, 506)} = 9.52$, $p<0.05$; to have=1.57, not to have=1.45).

For fines there were significant means group differences in Personal Physical Aggressive Expression ($F_{(1,\ 506)} = 6.32$, $p<0.01$; to have=1.11, not to have=1.08) and for Use of the Vehicle to Express Anger ($F_{(1,\ 506)} = 12.57$, $p<0.01$; to have=1.56, not to have=1.43).

5.3.5 DBQ Scale

The DBQ measures four types of behaviors, but in this study we had used three factors: Errors (stock failures planned in search of unintended results, including observation and judgment of action flaws), Ordinary Violations (disrespect deliberate to traffic laws) and Aggressive Violations (acts of hostility towards other participants of traffic). The total alpha of DBQ scale in this study was 0.87, for Errors it was 0.76, for Ordinary Violations it was 0.82, and for Aggressive Violations it was 0.73. Descriptive to DBQ are presented in Table 4.

Table 4: DBQ Factors Means

Scales*	Mean	SD
Ordinary Violations	1,13	0,80
Aggressive Violations	0,81	0,77
Errors	0,62	0,53

*Scales score from 0 for "never" to 5 for "almost always".

The analyses of group comparison were performed considering the three factors of DBQ (Ordinary Violations, Aggressive Violations and Errors) and groups: active accidents, passive accidents, gender and fines.

There was a significant group means difference for gender in Ordinary Violations ($F_{(1, 504)} = 15.70$, $p<0.01$; Male=1.27, Female=0.99). For another two factors, there were not significant differences.

Regarding active accidents, there were significant means group differences to Ordinary Violations factor ($F_{(1, 504)} = 44.23$ $p<0.01$; to have=1.51, not to have=0.99), Errors ($F_{(1, 507)} = 13.25$, $p<0.01$; to have=1.71, not to have=1.57), and Aggressive Violations ($F_{(1, 508)} = 29.97$, $p<0.01$; to have=1.11, not to have=0.70).

Regarding passive accidents, the differences between groups means were significant to Ordinary Violations ($F_{(1, 504)} = 18.39$, $p<0.01$; to have=1.38, not to have=1.04) and to Aggressive Violations ($F_{(1, 508)} = 23.49$, $p<0.01$; to have=1.09, not to have=0.72).

Regarding fines, there were significant groups means differences to Ordinary Violations ($F_{(1, 504)} = 39.90$, $p<0.01$; to have=1.42, not to have=0.97), and to Aggressive Violations ($F_{(1, 508)} = 13.05$, $p<0.01$; to have=0.97, not to have=0.72).

5.3.6 Hostility Scale and DSSS

The Hostility Scale was rated on a 5-point scale (1='not at all' to 5='very much'). The mean was 2.65 (SD = 0.56). Item 7 showed the highest result (M = 3.51, SD = 1.03), followed by the item 2 (M = 2.84, SD = 1.11). Cronbach's alpha was 0.61.

Regarding the significant means group differences, there was a significant difference to active accidents in Hostility Scale ($F_{(1, 504)} = 5.76$, $p<0.05$; to have=2.74, not to have=2.61) and to passive accidents ($F_{(1, 504)} =$ 5.97, p=0.01; to have=2.74, not to have=2.61). To gender and fines there were not significant differences.

To DSSS the mean was 0.48 (SD = 0.50), on a 4-point scale (1= "never" to 4 = "always"). Items 7 (M=1.06, SD 1.16) and 6 (M=1.05, SD=1.07) obtained the highest mean. Cronbach's alpha for the scale was .0.86. About significant group differences in DSSS there were found to gender ($F_{(1, 506)} =$ 39.00, p<0.01; Male=0.60, Female=0.34); active accidents ($F_{(1, 506)} =$ 12.40, p<0.01; to have=0.60, not to have=0.43), passive accidents ($F_{(1, 506)} =$ 8.32, p<0.01; to have=0.58, not to have=0.44), and fines ($F_{(1, 506)} =$ 13.08, p<0.01; to have=0.58, not to have=0.42).

The Sensations Seeking is associated with speed, the ideal speeds for drivers in different situations were asked. Why exceeding the speed limit? The participants answer: "for saving time" ("always" 17.2% or "often" 24.3%); "for being on time" ("always" 14.3% or "often" 17.7%). Moreover, participants reported that they drive "always" (3.2%) or "frequently" (3.8%) above the speed limit, to show off their skills, 11.9% of participants are "always" above the speed limit to go ahead, and 8.6% of them are often above the speed limit for pleasure.

In Brazil (2016) the maximum allowed speed is 110 km/h on main roads, 100 km/h in dual carriageways, 60 km/h in the country roads and 40 km/h in tow center. For the participants the ideal speed on main roads was 92.4 km/h (SD=51.38); in a dual carriageway was 76.9 km/h (SD=35.78), in the country road was 46.0 Km/h (SD=16.51) and in the town center, was 52.1 km/h (SD=26.79). Speed is related to DAX-BR' factor 'Use of the Vehicle to Express Anger' and Aggressive Violations from DBQ and higher sensation seekers.

5.3.7 Correlations between variables

We performed correlation analyses between DAX-BR and DBQ scales, DSSS and Hostility Scale, Table 5 shows the correlations that the types of anger expression have with the other variables. Almost all of the correlations are classified into the small to medium categories outlined by Cohen (1988): small (r = 0.10), medium (r = 0.30) and large (r = 0.50).

The Adaptative/Constructive Expression factor has a negative correlation with all the other DAX-BR's factors and the other scales. The other three factors had a large correlation among them and with DBQ's scales (Errors and Ordinary Violations).

Table 5: Correlations between variables

DAX-BR factors	1	2	3	4	Hostility	DSSS	Errors (DBQ)	Ordinary Violations (DBQ)	Aggressive (DBQ)	Violations
1- Verbal Aggressive Expression (DAX-BR)		0.54**	0.51**	-0.16**	0.39**	0.27**	0.85**	0.55**	0.40**	
2- Personal Physical Aggressive Expression (DAX-BR)			0.54**	-0.12**	0.33**	0.31**	0.57**	0.48**	0.30**	
3- Use of the Vehicle to Express Anger (DAX-BR)				-0.15**	0.33**	0.47**	0.63**	0.59**	0.52**	
4-Adaptive/Constructive Expression' (DAX-BR)					-0.18**	-0.10*	-0.20**	-0.16**	-0.21**	

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

5.3.8 Predictors of the violation types

Stepwise Linear Regression analyses were conducted to investigate the effects of the DAX-BR scales, together with other variables, in DBQ scales (dependent variable). Gender, Age, kilometers driven per year, and the number of years of drivers' license were entered on

Step 1; on Step 2 DSSS and Hostility scale were entered, in the Step 3 the DAX-BR factors were entered.

Table 6 shows the adjusted values of *R*2 for the DBQ scales. Each column indicates the accumulated adjusted *R*2, and significant p values are marked for the changes in *R*2 at each step.

Table 6: Hierarchical multiple regressions predicting four blocks types

DBQ factors	I (Gender,Age, Number of years of drivers' license, Km)	II (DSSS, HS)	III (DAX-BR)
Errors	0.02*	0.18**	0.78**
Aggressive Violations	0.03**	0.29**	0.48**
Ordinary Violations	0.07**	0.36**	0.45**

*. significant at the 0.05 level (2-tailed).

**. significant at the 0.01 level (2-tailed).

For all three DBQ factors all blocks contributed significantly as predictors. For the DBQ Errors factor the DAX-BR block explain significantly (R_2 change 60%). The DAX-BR block significantly contributed as predictors for Errors were Verbal Aggressive Expression (β=0.69, t=25.30, p<0.01), Use of the Vehicle to Express Anger (β=0.25, t=8.37, p<0.01), and Personal Physical Aggressive Expression (β=0.07, t=2.50, p<0.05).

The DAX-BR block increased (R_2 change 19%) the variance explained in the Aggressive Violations. The DAX-BR factors that contributed significantly as predictors for the DBQ Aggressive Violations factor were: Verbal Aggressive Expression (β=0.25, t=5.83, p<0.01), Use of the Vehicle to Express Anger (β=0.29, t=6.44, p<0.01), Personal Physical Aggressive Expression (β=0.09, t=2.06, p<0.05).

In the case of Ordinary Violations, the DAX-BR block increased 9% of the explained variance. The DAX-BR factors that were significant predictors for the DBQ Ordinary Violations were Verbal Aggressive Expression (β=0.17, t=3.79, p<0.01), Use of the Vehicle to Express Anger (β=0.24, t=5.28, p<0.01), Personal Physical Aggressive Expression (β=-0.09, t=-1.97, p<0.05) and adaptive/Constructive Expression (β=-0.11, t=-3.14, p<0.05).

Binary logistic regression was performed to verify if the gender variables, Number of years of drivers' license and exposition (how many Km they drive per year), the scales Errors, Aggressive and Ordinary Violations from DBQ, DSSS, hostility scale and DAX-BR are predictors of accidents and fines. The results are present in Table 7. For accidents and tickets, binary logistic regression was used, with Nagelkerke estimates for *R*2.

Table 7: Binary Logistic Regressions

	I (Gender,Age, Number of years of drivers' license, Km)	DBQ	(DSSS, HS)	DAX-BR
Accidents	0.05**	0.17**	0.17	0.17
Fines	0.22**	0.27**	0.28	0.28

*. significant at the 0.05 level (2-tailed).

**. significant at the 0.01 level (2-tailed).

For Accidents variable the block of Gender, Number of years of drivers' license and exposition (how many Km they drive per year), is a significant predictor for the model with [$x^2(3)$ =18.38; p<0.01, R^2 Negelkerke 0.049]. Also, DBQ block variable is the most significant predictor [$x^2(3)$ =45.97; p<0.01, R^2 Negelkerke 0.165]. DAX-BR block variable is not a significant predictor for accidents.

For fines variable block of Gender, Number of years of drivers' license and Km is a significant predictor [$x^2(4)$ =84,89; p<0.01, R^2 Negelkerke 0.217]. Also, the DBQ block variable is the most significant predictor [$x^2(3) = 22.62$; $p<0.01$, R^2 Negelkerke 0.268]. DAX-BR block variable is not a significant predictor for fines.

5.4 Discussion

The aims of this study were to provide evidence of validity and reliability to the Brazilian adaptation of the DAX (DAX-BR) and investigated the relationship between driving anger, traffic violations, hostility and sensation seeking.

The original structure of factors developed in the United States for the DAX appears to be applicable to our Brazilian version. However, six items (7, 8, 12, 13, 17 and 41) had ruled out because they obtained a factor loading below 0.30. A similar phenomenon had occurred in the DAX adaptation in other countries such as in France (Villieux & Delhomme, 2008) and in Romania (Sârbescu, 2012; Sullman et al., 2013).

For the DAX-BR scale the total Cronbach's alpha was 0.83 for 43 items. It was close to that founded in other countries: 0.85 in Serbia (Jovanovic et al., 2011); 0.88 in Romania (Sarbescu, 2012) and 0.82 in France (Villieux & Delhomme, 2007). Cronbach's alpha to Verbally Aggressive Expression factor (12 items) was 0.85, this value is closer to Jovanovic et al. (2012) value (0.88) and Sarbescu (2012) value (0.86). For Physically Aggressive Expression factor (11 tems), it was found Cronbach's alpha index of 0.69, far below than those values founded by Jovanovic et al. (2012) (0.85) and Sarbescu (2012) (0.86). For the subscale named Use of the vehicle to express anger (11 items) was found Cronbach's alpha value of 0.70, this value was closer to Javanovic et al. (2012) that got 0.77 and 0.83 of Sarbescu (2012). For the subscale adaptive/Constructive Expression, the alpha value was found 0.88 higher the value found by Javanovic et al. (2012) with 0.87 and Sarbescu with (2012) with 0.71.

Results show, as Villieux and Delhomme (2010), that DAX-BR is a good predictor for DBQ factors scales, especially for Errors, where was found that DAX-BR contributed to 60% in the explained model. For Aggressive Violations, also DAX-BR contributed with 19%, for Ordinary Violation was only with 9%. Findings also provided that DAX-BR factors correlated together, positively and strongly with the two types of traffic violations scales (Aggressive and Ordinary Violations), whereas negative correlations were observed between violations and the 'Adaptive/Constructive Expression' factor. As found by Deffenbacher et al. (2003), strong positive correlations were obtained between the factors of DAX-BR, Verbal and Physically Aggressive ($r = 0.54$) and between Physically Aggressive and Using the Vehicle for Aggressive (0.54). Violations from DBQ and Aggressiveness from DAX-BR have a strong positive correlation.

Regarding the Hostility scale, the score was close to Delhomme and Villieux (2008) with a French sample. Hostility has a medium correlation with DAX-BR as suggest by Delhomme and Villieux (2008) and it appears in most as a verbal way by the Verbal Aggressive Expression from DAX-BR. The DSSS average is below than Delhomme, Chaurand and Paran (2012): 2.14 ($SD = 0.75$). It was found that 41.5% of participants prefer drive above the local speed limit. Sensation seeking is positively related to traffic accidents, speeding, anger, disrespect for laws, and the possibility of aggression against other drivers (Arnett, 1990; Arnett, et al., 1997; Donovan, et al., 1985; Jonah, 1997; Jonah, Thiessen, & Au-Yeung, 2001; Trimpop & Kirkcaldy, 1997).

The Sensation Seeking scale was related to the participant's idea that the cause to exceed the speed limit is to save time. According to Villieux and Delhomme (2010) speed has a strong positive correlation with DAX factors Use of the Vehicle to Express Anger, because to drive faster is necessary to use the car in a more aggressive way and with Violations factors from DBQ; and with higher sensation seekers to adopt risky driving behaviors speeding (Delhomme et al., 2012).

Different performances results were found to accident groups (active and passive) for DAX-BR, DBQ, DSSS and Hostility scales showing that that is imported to do focus studies with different groups types (Sullman, 2006, González-Iglesias et al., 2012). For Accidents (active and passive) and fines DAX-BR was not a reliable predictor.

The highest average of the DAX-BR was obtained in adaptive/Constructive Expression, followed by Verbal Aggressive, then Use of the Vehicle to Express Anger and finally Physically Aggressive Expression factor. The mean´s order of the DAX-BR subscales are the same as that found by González-Iglesias et al. (2012) in Spain, but the values obtained in the DAX-BR were higher. In the study of Sarbescu (2012) in Romania the averages were higher than those obtained in this study with: Verbal Aggressive; Use of the Vehicle to Express Anger; Adaptive/Constructive Expression and Physically Aggressive. The averages obtained, in France, by Villieux and Delhomme (2010) in general were also higher, only adaptive/Constructive Expression was lower, in sequence with higher values came Verbal Aggressive, then Use the Vehicle to Express Anger and then Physically Aggressive Expression. This could be a point to indicate that the scale work in the same way in different countries.

This research has some methodological limitations. One is the use of a sample of youngster students; because they don´t drive very often, however, our results were relatively similar to those previously found in different samples (Villieux & Delhomme, 2008; Villieux & Delhomme, 2010; Sârbescu, 2012). A second limitation is that the DAX-BR test-retest reliability was not assessed in this study. Another limitation is the issue of social desirability and the use of questionnaires to assess the range of driving, their expressions and behavior violations, traffic violation types and speed limits. However, the use of those instruments is frequent in this area of research, and many researchers have indicated significant positive relationships between statements of drivers and their actual behaviors while driving (Stephens & Groeger, 2011; Sullman, 2015). In this study participants were undergraduate students in Curitiba City, for future studies a sample from other cities, or other participants profile, would be recommended.

As a practical application this Brazilian adaptation of DAX (DAX-BR) could be used in Brazil when drivers are trying to get the license for drive. So it is possible to know what the situation changes driver reactions, for instance to help prevention experts to carry out more effective intervention strategies to reduce driver anger and work to prevent it during the driver training and drivers refresher courses.

Angry drivers must unlearn to have hostile actions in general, for this, the use of cognitive therapy, associated with self-control strategies and relaxation are indicated (Deffenbacher et al., 2000; Deffenbacher, Oetting & DiGiuseppe, 2002). Technology can also help with the use of appliances in the car which detect the driver's state of anger, helping to contain and prevent late consequences.

For further research, it could be used in the DAX-BR scale by car professional drivers (Uber drivers or taxi drivers) and motorcycle drivers, for example. DAX-BR will be useful to help with the reduction of traffic violations since it gives a better dimension of this phenomenal since those types of drivers drive more daily and have more changes to be involved in a car accident or committee a traffic Violations.

There is validity evidence to use the DAX-BR as the original structure version to evaluate aggressiveness in driving context in Brazil. Other points is that DAX-BR shows good parametric properties and could be an important instrument to be used in future research about anger aspects of young drivers or to be used as a complementary instrument with other types of research.

In total, other studies should be conducted to provide further validity of the DAX-BR in different types of population for instance, older and more experienced drivers compared to the students in this first study, traffic regulation offenders who lost their driving license.

6. Second Study: Use of DAX-BR to a Brazilian offender drivers sample

6.1 Introduction

Aggressiveness while driving was identified as a significant traffic safety problem (Sarbesc, Stanojevic & Jovanovic, 2014). However, only in the last two decades, the problem of aggressiveness during driving has been updated and now it is considered a global problem (Sarbesc, Stanojevic and Jovanovic, 2014; Sullman 2015). So, it is crucial to measure aggressiveness and anger as traits and or as state to try to reduce the weight of these factors in road accidents. The main objective of this second study was conducted to provide further validity of the DAX-BR in focusing on a population of drivers on retraining courses to regain the right to drive, different from the population in study 1.

Aggressive driving contributes to a third of personal injury, and to two thirds of all deaths caused by traffic accidents. These results, that 56% of accidents generated fatal victims between 2003 and 2007 in Serbia (Sarbesc, Stanojevic & Jovanovic, 2014). Aggressiveness is responsible for 65% of car accidents in Saudi Arabia (Akhdar et al., 2000); and results in similar number of professional drivers in Northern Kosovo (Sants et al., 2012). Anger is an emotion that is commonly experienced while driving (Underwood et al., 1999). Individuals who reported high levels of anger are more likely to be aggressive in driving (Lawton and Nutter, 2002; Sullman, 2015). This is perhaps one of the reasons why the issue of anger in driving seems to have gained popularity among researchers over the past 15 years (eg, Deffenbacher et al., 2001b; Maxwell et al., 2005;.Parker et al. 2002; Underwood et al., 1999; Sullman, 2006; Sullman et al., 2007; Sullman & Stephens, 2013; Sullman, 2015). Another reason for the growing popularity of this topic is that angry drivers engage more often in harsh and dangerous driving behaviors (Stephens & Groeger, 2011; Sullman, 2015) by endangering other drivers (Deffenbacher et al., 1994; Deffenbacher et al., 2001b; Lajunen et al., 1998; Maxwell et al., 2005; Underwood et al., 1999). There are significant relationships between driving anger and risky factors such as, high-speeding, sudden maneuvers and other violations, with driving-related sensation seeking (Deffenbacher et al., 2001b ; Deffenbacher et al., 2003a; Deffenbacher et al. 2003b; Sullman et al., 2013; Sullman, 2015).

As exposed in study 1, in order to measure the ways in which individuals respond to anger while driving Deffenbacher et al. (2002) developed the Driving Anger Expression Inventory (DAX). The most common version of the used DAX comprises 49 items and four factors: a) verbal aggressive expression - verbally expressing anger (12 items); b) personal physical aggressive expression - using themselves to express anger (11 items) – c) use of the vehicle to express anger (11 items); and d) Adaptive/Constructive expression (15 items).

Some researchers have reduced the number of factors of the original model. For example, Sarbescu (2012) reported the three-factor model using 30 items, which combined verbal and physical aggression on a single factor. Villieux and Delhomme (2010) reported a three-factor solution using only 11 of the original 49-items, Also Sullman (2015) uses a three factors solution. However, some researchers use the four-factor model, but only accept the results after a few adjustments (Sullman et al., 2013). Deleting items in the DAX forms or using a reduced number of items is common (Villieux and Delhomme, 2010; Stephens & Sullman, 2014; Sullman, 2015; with 4 factors).

Another point of DAX method is that studies have focused primarily or exclusively on college students (Deffenbacher et al., 2001a; Deffenbacher et al., 2002; Deffenbacher et al. 2003; Dahlen and Ragan, 2004; Deffenbacher et al., 2004; Deffenbacher et al., 2007; Esiyok et al, 2007; Moore and Dahlen, 2008; Villieux and Delhomme, 2010; Herrero-Fernández, 2011; Sullman, 2015). However, there is no DAX study that worked with offenders drivers, or that worked with recycling driving courses, even outside the United States such as France (Villieux and Delhomme, 2010), Spain (Herrero-Fernandez 2011), Turkey (Esiyok et al, 2007; Sullman et al., 2013), Serbia (Jovanovic et al., 2011), England (Stephens & Sullman, 2014), New Zealand (Sullman, 2015), and Malaysia (Sullman, et al., 2015).

The offender drivers tend to commit more traffic violations and tend to receive more fines (Brasil, 2015). Violations are positively correlated with accidents and driving aggressiveness (Sullman, 2015). Violations also negatively correlated with the perception of risk (Oliveira, 2008). The positive correlation between anger while driving and violation behaviors measured with DBQ are well established during decades (such as Baron & Richardson, 1994; Berkowitz, 1993; Coie & Dodge, 2000; Jovanovic et al, 2011; Gras, et al., 2006; Lajunen & Summala, 2003; Lawton, et al., 1997; Reimer et al, 2005). Initially the DBQ was developed to empirically distinguish between two different classes of behaviors, errors and violations (Lajunen & Summala, 2003). DBQ is an instrument which measures the self-reported frequency of three-risk behaviors in driving: (a) failure error shares, designed to achieve the objective and, consequently, could produce potentially dangerous results; (b) intentional violation practices deemed necessary to maintain a safe operation and; (c) lapses of attention and memory failures that can cause embarrassment, but have no impact on the safety while driving (Reason et al., 1990). The original questionnaire includes 50 items (Reason et al., 1990). The version used in Brazil contains 28 items originally created by Lawton et al. (1997), adapted by Bianchi and Summala (2002). Using this DBQ-BR, the authors found that men committed more violations than women. Analyzing the differences by age group, the youngers (up to 22 years) commit more Ordinary Violations and more errors than older drivers, and the differences between their means were significant (Maoski, 2014; Resende, 2015).

Aggressive driving can be a product of circumstances and individual differences, a driver who adopts aggressive driving style can maintain a desire to seek the risk and therefore to be involved in accidents (Bachoo et al., 2013). Some of the predictors include aggressive driving, risk behavior and sensation seeking (Bachoo et al., 2013; Stephens & Sullman, 2015). Sensation seeking is positively related to involvement in crashes and it is responsible for 10-15% of the variance in risky driving behaviors. This includes behaviors such as speeding, violating traffic laws, and noncompliance with vertical road signs (Stephens & Sullman, 2015).

The access of personality traits focusing on specific areas, Taubman et al. (1996; Yagil, 2001) developed a specific scale in the driving context: the Driving-related sensation seeking (DSSS). The DSSS contains items related to speeding and other related emotion, and was positively related to risky driving in high speed (Delhomme, Verlhiac & Martha, 2011). Men reported more accidents and traffic offenses compared to women and men are the high-risk group for traffic accidents, mainly due to the aggressive way they drive and seek sensations (Delhomme et al., 2011). The male drivers may be more prone to accidents because they have certain personality traits that make them, underestimate the danger and take more risks (higher sensation seeking),(Constantinou et al., 2011; Passa et al., 2013).

Research from Sullman and Stephens (2015) found that people with a more aggressive profile become more involved in accidents. People who have a lower perception of being caught (receive a fine or trouble with the Police) tend to get more sensations and end up getting involved in more accidents (Passa et al., 2013).

6.2 Brazilian Rehabilitation Training Courses

In Brazil, it was established, by the Traffic Code (Brazil, 1997) significant relationship between aggression and violations. Drivers have twenty demerit points on their driving license per year. The driver who commits an offense receives a penalty ranging from three, four, five and seven points. When the sum of violations exceeds 20 points limit during a year, the driver receives a suspension of the driving license. In order to permit receiving the right to conduct again, the offending driver must take a course of at least 30 hours (Contran, 2014). The course is divided in: - 12 hours of classes about traffic laws; - 8-hour of classes about defensive driving; - 4 hours of classes about first aid and 6 hours of intrapersonal relationship. At the end of each module, the driver needs to realize a test and must obtain a minimum score to proceed. In Paraná State in Brazil, in the last four years 200,000 drivers did the recycling course (Detran- PR, 2014).

The aim of this study is to provide further validity of the DAX-BR (Olandoski, Bianchi & Delhomme, 2017) among a offender driver sample in testing the DAX-BR psychometrics properties to investigate its relationships with risky behaviors (DBQ), accidents, fines, and driving sensation seeking.

6.2.1 Participants

The sample was composed of 602 drivers coming from the courses to regain the driver’s license (75.6% men) surveyed from three different places in the Curitiba City (Paraná State). The mean age of participants was 39.31 years old (SD=12.91, range= 21 to 85). They had their driver's license during 1 to 60 years (M= 18.01 years, SD=11.51) and reported driving a means of 20617 Kilometers per year (SD= 27995.20, ranges 4000 to 120000) since receiving their driver’s license.

Regarding education levels, participants reported that 9% had not completed elementary school, 4.7% only completed the elementary school, 10.5% had not completed high school, 22% completed high school, 14% had incomplete college level, and 39.9% had a college degree. For the driving frequencies 1.2% drives once a week, 1% two days a week, 5.3% three days a week, 3% four days a week, 7% five days a week, 9.1% six days a week, 66.3% drive every day and 5.5% rarely drive.

The data from the accidents were classified into active accidents (when the driver causes an accident) and passive accidents (when the driver is involuntarily involved in an accident).

Regarding active accidents with only damage, occurred over the past five years, 16.1% of participants reported having been involved in a car accident with minor damage once, 4.6% twice and 1.9% three times, 4.1% of participants reported having been involved in a car accident with medium damage once, 0.5% twice, and 0.9% of participants reported having been involved in a car accident with great damage.

Regarding passive accidents with minor damage over the past five years, 19.5% of the sample reported having been involved in a car accident with minor damage once, 6.1% twice and 1.5% three times; 3.7% of the sample reported having been involved in a car accident with medium damage suffered once, 0.8% twice, and 1.9% of the sample experienced a time a car accident with great damage.

To better understand which factor is a significant for prediction of accident, this factor was transformed into a dependable binary variable. In the sample, 22.8% of participants had produced an active accident and 28.6% had suffered a passive accident.

Regarding fines, 60%, of participants reported having received a fine for over speeding, 23.6% for driving and talking on a cell phone, 16.4% of participants have had fines for crossing at a red signal light, 8% had been fined for driving under the influence of alcohol and 3.8% received a fine for stopped over the pedestrian lane.

6.2.2 Measures

(1) The adaptation of the Driving Anger Expression Inventory (DAX; Deffenbacher, Lynch et al., 2002) to Portuguese with 43 items by (Olandoski, et al., 2017) named DAX-BR. Participants rated items on a 4-point scale (1='almost never' to 4='almost always') according to the degree to which they express their anger while driving in the manner described in the item.

(2) The 28 items Driver Behaviour Questionnaire –DBQ Reason et al. (1990) adapted to use in Brazil by Bianchi and Summala (2002) divided into four factors Errors, Aggressive Violations, Ordinary Violations and Lapses with a range rated items on a 6-point scale (0 = 'never' to 5 = 'always'). They were used errors, Ordinary Violations and Aggressive Violation factors in this study.

(3) The unifactorial Driving Sensation Seeking Scale - DSSS (Taubman et al., 1996) adapted to Portuguese by (Olandoski et al., 2017). The scale contains 7 items rated items on a 4-point

scale (1= "never” to 4 =”always'). Cronbach’s alpha scale was .0.73 the same as Delhomme, Chaurand and Paran (2012) and lower than Olandoski et al. (2017).

(4) Socio-demographic variables were registered about age, gender, kilometers driven since receiving a driver's license and the year of license, the types of accidents as a driver and number of fines received in the last five years, as well as the maximum speed that drivers drive on various road types: main roads, on dual carriageways, and country roads (Delhomme, Cristea & Paran, 2014).

6.2.3 Procedure

Participants completed the four measures in a single section. The measures were presented in this sequence: DAX-BR, DBQ, DSSS and, the socio-demographic variables. Participants were given instructions to take part in a study, carried out by a student for his thesis, on various aspects of driving behavior with the goal of better understanding the driver’s habits. Also, it was assured that the answers would be treated with strict confidentiality and anonymity attending ethical procedures.The entire process took less than 30 minutes, in mean, to be completed.

6.3 Results

The findings are reported in five parts. The first part is focused on the DAX-BR. We expose the descriptive statistics (means and standard deviations) then for the internal structure analysis of DAX-BR, and an exploratory factorial analysis (AFE). First, the factor of the 49 original items that composes the DAX-BR Scale was checked using the Kaiser-Meyer-Olkin criterion (KMO) (Field, 2009). Afterwards, we examined the internal consistency of DAX-BR factors assessed using the Cronbach's alpha coefficient. Comparisons among groups on accidents, gender and fines are conducted for each factor of the DAX-BR presents the results of the confirmatory factor analysis (CFA) to examine its factorial structure.

The CFA was performed over the variance covariance matrix using the AMOS statistical package, the goodness-of-fit for the model was assessed using the chi-square statistic, the Index (GFI), the Adjusted Goodness of Fit Index (AGFI), the Incremental Fit Index (IFI), the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA).

The second part of results is focused on the DBQ, the third one is focused on Hostility scale and on DSSS. The fourth part presents correlations between all variables used in this study before exposing in the last fifth part of the results, the predictors of the violation types. To elucidate if DAX-BR factors are significant predictors, linear and binary regressions were performed.

6.3.1 DAX-BR - Factor Analysis of Driving Anger Expression Inventory

6.3.1.1 Descriptive analysis

Means and standard deviations for all DAX-BR items are presented in Table 8.

Table 8: DAX-BR Items.

DAX-BR items*	M	SD

1. I give the other driver the finger.	1.20	0.50
2. I drive right up on the other driver's bumper.	1.28	0.56
3. I drive a little faster than I was.	1.60	0.63
4. I try to cut in front of the other driver.	1.25	0.52
5. I call the other driver names aloud.	1.32	0.59
6. I make negative comments about the other driver aloud.	1.54	0.74
7. I yell questions like ‘Where did you get your license?’	1.22	0.49
8. I roll down the window to help communicate my anger.	1.17	0.46
9. I glare at the other driver.	1.33	0.57
10. I call the other driver names under my breath.	1.54	0.79
11. I speed up to frustrate the other driver.	1.25	0.56
12. I purposely block the other driver from doing what he/she wants to do.	1.19	0.50
13. I go crazy behind the wheel.	1.21	0.51
14. I leave my brights on in the other driver's rear view mirror.	1.25	0.56
15. I try to force the other driver to the side of the road.	1.13	0.48
16. I try to scare the other driver.	1.17	0.56
17. I do to other drivers what they did to me.	1.35	0.76
18. I pay even closer attention to being a safe driver.	2.34	1.13
19. I think about things that distract me from thinking about the other driver.	2.11	1.06
20. I think things through before I respond.	2.42	1.10
21. I try to think of positive solutions to deal with the situation.	2.33	1.09
22. I drive a lot faster than I was.	1.76	0.99
23. I swear at the other driver aloud.	1.70	0.97
24. I tell myself it's not worth getting all mad about.	2.26	1.11
25. I decide not to stoop to their level.	2.29	1.13
26. I swear at the other driver under my breath.	2.02	1.05
27. I turn on the radio or music to calm down.	2.12	1.06
28. I flash my lights at the other driver.	1.90	1.07
29. I make hostile gestures other than giving the finger.	1.70	1.03
30. I try to think of positive things to do.	2.22	1.10
31. I tell myself it's not worth getting involved in.	2.34	1.13
32. I shake my head at the other driver.	2.06	1.08
33. I yell at the other driver.	1.65	0.94
34. I make negative comments about the other	1.70	0.92

driver under my breath.		
35. I give the other driver a dirty look.	1.79	0.97
36. I just try to accept that there are bad drivers on the road.	2.03	1.07
37. I think things like 'Where did you get your license?'	2.08	1.06
38. I do things like take deep breaths to calm down.	2.23	1.06
39. I just try to accept that there are frustrating situations while driving.	2.15	1.05
40. I slow down to frustrate the other driver.	1.87	1.04
41. I think about things that distract me from the frustration on the road.	2.05	1.07
42. I tell myself to ignore it.	2.24	1.20
43. I pay even closer attention to other's driving to avoid accidents.	2.30	1.18

* 4-point scale (1='almost never' to 4='almost always')

Responses to 43 items of the Driving Anger Expression Inventory scale were subjected to a principal axis analysis with an oblimin rotation and Kaiser normalization procedure.

The Kaiser-Meyer-Olkin (KMO) measure (0.80) and Bartlett`s test of Sphericity ($p<0.001$) were calculated, indicating that it is appropriate to perform principal axis analysis with an oblimin rotation which suggested that partial correlations among the items were large enough for factoring. Bartlett`s test of Sphericity was large and significant which suggested that the item-correlation matrix was not an identity matrix; the test shows a Chi-square value of 7810 (df= 1176, $p<0.001$).

To test the original four factors model in Brazil, a four factors extraction was attempted. Together those four factors accounted for 32% of the total amount of variance. Inclusion and exclusion criteria were set up at 0.30.

Other ideas were the use of five factors proposed by Herrero-Fernández (2011) or reducing the use of factors and items as Sarbescu (2012) Villieux and Delhomme (2010) or number of items and transform the DAX-BR in a Shorter Scale as done by Gonzalez-Iglesias, Gómez-Fraguela and Martín Luengo (2012); Sullman et al. (2013); Stephens and Sullman (2014).

A factor analysis was conducted, items that did not get a load of more than 0.30 were deleted. The items of the Adaptive/Constructive factor remained unchanged since obtained a good fit alpha of 0.85; however the other three factors were redistributed into two new factors, as were very diffuse and dispersed. The global alpha value was 0.83 and for each of the DAX factors, Cronbach's alphas were between 0.85 and 0.70. The factorial structure of the scale was checked through exploratory factor analysis (EFA). The items: 28 "I speak bad words for other drivers", 31 "I speak expletives under his breath", 33 "I play highlight the other driver", 37 "I shake my head to the other driver", 38 "I yell at other drivers"; 39 "I whisper negative comments about the other driver", did not get a good fit and a good load and were excluded from the proposed model. Table 9 shows the means, SD, and the factor loads of the model.. The first factor was called Verbal and Physical Factor, the second factor was called Projective Factor and the Third still Adaptive/Constructive Factor.

Table 9: DAX-BR items and factors.

DAX-BR items/factors	**Verbal and Physical Factor (F1)**	**F1**	**F2**	**F3**
3. I drive a little faster than I was.		**0.457**	0.082	0.011
6. I make negative comments about the other driver aloud.		**0.669**	0.03	-0.092
14. I call the other driver names under my breath.		**0.476**	0.151	-0.175
11. I glare at the other driver.		**0.664**	0.043	0.076
5. I call the other driver names aloud.		**0.617**	0.011	-0.017
2. I drive right up on the other driver's bumper.		**0.431**	0.012	-0.017
4. I try to cut in front of the other driver.		**0.412**	-0.019	0.09
15. I speed up to frustrate the other driver.		**0.42**	-0.048	0.185
19. I leave my brights on in the other driver's rear view mirror.		**0.425**	-0.027	0.26
9. I yell questions like 'Where did you get your license?'		**0.487**	0.038	0.011

18. I go crazy behind the wheel.	**0.461**	-0.032	0.208
1. I give the other driver the finger.	**0.448**	-0.009	0.106
16. I purposely block the other driver from doing what he/she wants to do.	**0.49**	-0.085	0.081
10. I roll down the window to help communicate my anger.	**0.506**	-0.056	0.084
Projective Factor (F2)	**F1**	**F2**	**F3**
46. I slow down to frustrate the other driver.	0.289	**0.403**	0.029
27. I drive a lot faster than I was.	-0.081	**0.452**	0.009
34. I make hostile gestures other than giving the finger	0.147	**0.536**	-0.046
22. I do to other drivers what they did to me.	0.006	**0.587**	0.211
21. I try to scare the other driver.	-0.074	**0.699**	0.11
20. I try to force the other driver to the side of the road.	-0.066	**0.649**	0.127
Adaptative and construction Factor (F3)	**F1**	**F2**	**F3**
25. I think things through before I respond.	-0.051	-0.119	**0.624**
23. I pay even closer attention to being a safe driver.	-0.128	0.07	**0.562**
36. I tell myself it's not worth getting involved in.	-0.223	-0.042	**0.66**
26. I try to think of positive solutions to deal with the situation.	-0.134	-0.178	**0.481**
49. I pay even closer attention to other's driving to avoid accidents.	-0.212	0.075	**0.563**
30. I decide not to stoop to their level.	-0.022	-0.069	**0.518**
29. I tell myself it's not worth getting all mad about.	-0.041	-0.08	**0.537**
48. I tell myself to ignore it.	-0.06	0.006	**0.678**
44. I do things like take deep breaths to calm down.	0.084	0.122	**0.635**
35. I try to think of positive things to do	-0.004	-0.112	**0.638**
45. I just try to accept that there are frustrating situations while driving.	0.12	0.126	**0.505**
32. I turn on the radio or music to calm down.	0.121	0.086	**0.455**
24. I think about things that distract me from thinking about the other driver.	0.079	-0.04	**0.543**
43. I think things like ‘Where did you get your license?	0.204	0.239	**0.496**
47. I think about things that distract me from the frustration on the road.	0.165	-0.017	**0.555**
42. I just try to accept that there are bad drivers on the road.	0.087	0.184	**0.523**

6.3.2 Confirmatory Factor Analysis

First, we used the DAX-BR structure, from our study 1, and the results showed a model obtained weaker fits, with $\chi 2$ (1121) = 4554 pb.001; $\chi 2$ / 4554= 4.06; GFI = .73; AGFI = .70; IFI = .50; CFI = .50; TLI = .48; RMSEA = .07.

The best model that obtained a reasonable fit index, was the one that uses three factors. After the adjustments the CFA to this model proved as follows: $\chi 2$ (646) = 1959.04 pb.001; $\chi 2$ / 1959.04 = 3.03; GFI = .85; AGFI = .83; IFI = .76; CFI = .76; TLI = .74; RMSEA = .05. Usually, a non-significant chi-square and values greater than .85 for the GFI, AGFI, IFI, CFI, and TLI considered reflecting an acceptable model fit. In addition, an RMSEA value of less than .05 indicates close fit and values up to .08 indicate reasonable errors of approximation (Villieux & Delhomme, 2008).

6.3.3 Internal consistency

The internal consistency was tested using Cronbach's alpha, the DAX-BR has satisfactory reliability scores for the total scale (α=.83) and for each of the four factors (α's ranging from .70 to .85).

The 'Adaptive/Constructive Expression' factor had the highest rating (M=2.22), with item 20.`I think things through before I respond` having the highest mean observed (M=2.42). The Projective DAX-BR factor had a mean (M=1.50) and the Verbal and Physical factor had a mean (M=1.34). The 15'. I try to force the other driver to the side of the road had the lowest mean (M=1.13). The table 10 shows the Means, SD and alphas of the DAX-BR

Table 10: Means, SD and alphas to DAX's-BR Factors.

DAX-BR factors	M	SD	Cronbach's alpha
Verbal and Physical	1.34	0.30	0.78
Projective	1.50	0.50	0.70
Adaptative and Constructive	2.22	0.62	0.85

*4-point scale (1='almost never' to 4='almost always')

6.3.4 Results about group differences for each DAX-BR factors

A one-way between subjects ANOVA was conducted compare the differences between groups by passive and active accidents, gender and fines on DAX-BR factors. The total number of participants in each group is: to active accidents (to have =137 drivers or not to have =467 drivers), passive accidents (to have =172 drivers or not to have = 430 drivers), gender (male =455; female =147) and fines (to have = 49 drivers or not to have = 553 drivers).

There was not a significant difference between groups by gender in DAX-BR factors. For the active accidents (to have or not to have) there were significant means group differences in Verbal and Physical DAX-BR factor ($F_{(1, 600)} = 16.90$, $p<0.05$; to have=1.43, not have=1.30).

In passive accidents the difference between groups means was significant for Verbal and Physical Factor ($F_{(1, 600)} = 8.73$, $p<0.05$; to have=1.40, not have=1.32).

For fines there were significant means group differences in Verbal and Physical DAX-BR ($F_{(1, 600)} = 5.67$, $p<0.01$; to have=1.35, not have=1.25) and for Projective DAX-BR Factor ($F_{(1, 600)} = 4.69$, $p<0.01$; to have=1.51, not have=1.36).

6.3.5 DBQ Scale

The DBQ measures four types of behaviors, but in this study we had used three factors: Errors (stock failures planned in search of unintended results, including observation and judgment of action flaws), Ordinary Violations (disrespect deliberate to traffic laws) and Aggressive Violations (acts of hostility towards other participants of traffic). The total Cronbach's alpha from DBQ scale in this study was 0.87; Errors were 0.77, Ordinary violation was 0.84 and Aggressive Violation was 0.68. Descriptives to DBQ are presented in Table 11.

Table 11: Descriptive to DBQ.

Factor	Mean	SD
Ordinary violations	0.58	0.63
Aggressive violations	0.65	0.39
Errors	0.47	0.53

*Scales from 0 behavior frequency score for "never" to 5 for "almost always".

The analyses of group comparison were performed considering the three factors of DBQ (Ordinary Violations, Aggressive Violations and Errors) and groups: active accidents, passive accidents, gender and fines.

There was a significant group means difference for gender in Ordinary Violation ($F_{(1, 555)} = 4.27$, $p<0.05$; Male=0.59, Female=0.46) and also in Errors ($F_{(1, 549)} = 4.23$, $p<0.05$; Male=0.48, Female=0.37).

Regarding accidents, there were significant means group difference for active accidents in Ordinary Violations factor ($F_{(1, 555)} = 14.64$ $p<0.01$; to have=0.74, not have=0.50) and also in Aggressive Violations ($F_{(1, 560)} = 10.74$, $p<0.01$; to have=0.64, not have=0.43).

In passive accidents, there were significant means group difference for accidents in Ordinary Violations factor ($F_{(1, 555)} =$ 7.37 $p<0.01$; to have=0.67, not have=0.51) and also in Aggressive Violations ($F_{(1, 560)} =$ 6.19, $p<0.05$; to have=0.58, not have=0.43).

Regarding the fines, there was a significant group means difference in Ordinary Violations ($F_{(1, 555)} =$ 9.58, $p<0.01$; to have=0.58, not have=0.27).

6.3.6 DSSS

The DSSS is a unifactorial Likert scale with 1 to 4 points was obtained a medium 0.33 (SD 0.37). The scale had a.0.73 alpha. Item number one had the highest mean 0.68 (SD=1.54). There was a significant group means difference for gender in DSSS ($F_{(1, 549)} =$19.64, $p<0.05$; Male=0.37, Female=0.20).

Regarding accidents, there was a significant means group difference for active accidents in DSSS ($F_{(1, 549)} =$3.76 $p<0.01$; to have=0.41, not have=0.37).

Sensation Seeking is positively higher correlation with Speed. For the Speed Limit, 49.4% of participants said that they drive above the speed limit in the town center, 32.5% rarely and 17.9% never do. On main road, 52.7% of participants reported that they drive above the speed, 25.7%, rarely and 21.4% who never do. On carriageways, 25.4% of participants reported that they exceed the speed limit, 33.7% rarely and 30.8% never do. On country roads, 19.8% of participants reported that they run above the speed limit, 19% rarely and only 30.7% never do. They reported that they run above the speed limits for professional commitment (56.3%), for pleasure (27.7%), for saving time (19.7%) and to show their skills (16.4%).

6.3.7 Correlations between DAX-BR, DBQ and DSSS

We performed correlation analyses between DAX-BR and DBQ scales, DSSS and Hostility Scale, Table 12 shows the correlations between the types of anger expression have with the other continuous variables. Almost all of the correlations fall into the small to medium categories outlined by Cohen (1988): small (r =0.10), medium (r =0.30) and large (r =0.50). Positive correlations were found in Adaptive/Constructive DAX-BR Factor and Ordinary Violations, Projective DAX-BR Factor and Aggressive Violation, Error and Ordinary Violations.

Table 12: Correlation between DAX-BR, DBQ and DSSS

	1	2	3	Errors(DBQ)	Ordinary Violation(DBQ)	Agressive Violation(DBQ)	DSSS
Verbal and Physical Factor		0.05	0.04	0.01	0.03	0.04	0.06
Projective Factor			0.13**	0.11**	0.08	0.11**	0.24**
Adaptative and Constructive Factor				0.28**	0.45**	0.48**	0.30**

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

6.3.8 Predictors of the Violation Types

Stepwise Linear Regression analyses were conducted to investigate the effects of the DAX-BR scales, together with other variables, in DBQ scales (dependent variable). Gender, Age, kilometers driven per year, and the number of years of drivers' license were entered on Step 1; on Step 2 DSSS scale was entered, in the Step 3 the DAX-BR factors were entered.

Table 13 shows the adjusted values of $R2$ for the DBQ scales. Each column indicates the accumulated adjusted $R2$, and significant p values are marked for the changes in $R2$ at each step.

Table 13: Hierarchical multiple regressions predicting four blocks types.

	Gender,Age, Number of years of drivers' license, Km	II (DSSS)	DAX - BR
Errors	0.01*	0.03**	0.11**
Aggressive Violations	0.03**	0.08**	0.31**
Ordinary Violations	0.03**	0.14**	0.28**

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

For all three DBQ factors, all blocks contributed significantly as predictors. For the DBQ Errors factor, the DAX-BR block explains significantly (R_2 change 8%). The DAX-BR block significantly contributed as predictors for Errors were Verbal and Physical DAX-BR Factor (β=0.30, t=5.42, p<0.01).

In Aggressive Violations, factor DAX-BR block explains significantly (R_2 change 23%). was a reliable predictor. The DAX-BR factors that contributed significantly as predictors for the DBQ Aggressive Violations factor was Verbal and Physical (β=0.51, t=10.38, p<0.01).

In the case of Ordinary Violations, the DAX-BR block increased 14% the variance explained. The DAX-BR factors that were significant predictors for the DBQ Ordinary Violations factor was Verbal and Physical Factor (β=0.41, t=8.22, p<0.01).

Binary logistic regression was performed to verify if the gender variables, Number of years of drivers' license and exposition (how many Km they drive per year), the scales Errors, Aggressive and Ordinary Violations from DBQ, DSSS scales and DAX-BR are predictors of accidents and fines. The results are present in Table 14. For accidents and tickets, binary logistic regression was used, with Nagelkerke estimates for *R*2.

Table 14: Binary Logistic regressions

	I (Gender,Age, Number of years of drivers' license, Km)	DBQ	(DSSS)	DAX-BR
Accidents	0.07**	0.15**	0.15	0.16
Fines	0.03	0.07	0.08	0.12

*. significant at the 0.05 level (2-tailed).

**. significant at the 0.01 level (2-tailed).

For Accidents variable the block of Gender, Number of years of drivers' license and exposition (how many Km they drive per year), is a significant predictor for the model with [$x^2(4)$ =17.43; p<0.01, R^2 Nagelkerke 0.069]. Also, DBQ block variable is the most significant predictor [$x^2(3)$ =21.49; p<0.01, R^2 Nagelkerke 0.15]. DAX-BR block variable is not a significant for accidents. For fines variable any block wasn´t a significant predictor.

6.4 Discussion

This study was conducted to provide further validity of the DAX-BR in a distinct and larger population of the city of Curitiba. This second study was focused on a population of drivers on retraining courses to regain the right to drive because they used to be more aggressive drives since they had committed many violations and received several traffic fines. This second study had two aims: to test if the first DAX-BR structure scale works out in a different type of sample, and to know how personal and personality traits work with more aggressive sample drivers.

The second hypothesis tested was that the sample of second studied would have higher aggressively results than the first sample. Because this population comes from refresher course to regain the possibility of the right to drive cars and that the DAX-BR factorial structure of first study should apply for this population.

The adaptation of the DAX-BR was made using an undergraduate student sample (Olandoski et al., 2017) and it is imported to test the proprieties of the scale with a different sample. After factorial analysis, six items have been deleted (28, 31, 33, 37, 38, 39), because they have not obtained a minimum factor loading (0.30). Most of those items are from factors 'Use of the Vehicle to Express Anger' and 'Personal Physical Aggressive Expression' This can be explained by Maoski (2014), who shows that Brazilian drivers have a very strong relationship with their car and do not even think about using their vehicle to express their anger in traffic, as measure the factor 'Use of the Vehicle to Express Anger'. Regarding the factor 'Personal Physical Aggressive Expression', the offender drivers received fines for traffic violations, but do not necessarily intended to harm other drivers. Then, the final scale was reduced from four into three factors: 'Verbal and Physical', 'Projective', and 'Adaptative and Construction'. The proposed use of three factors has support from Sârbescu et al. (2014).. In other studies when adapted for a particular population DAX suffered changes in its structure (Herrero-Fernández, 2011; Villieux and Delhomme, 2008), or in the number of items (Sarbescu, 2012; Villieux and Delhomme, 2010; Sullman, 2013, 2015; Stephens & Sullman, 2014).

Our second hypothesis in this study stated that the sample would have higher aggressively results than the first sample, because they were offender drivers. Aggressiveness in traffic can be expressed in a direct way, like in aggressive violations scale from DBQ, or in a less direct way as speeding or Ordinary Violations scale from DBQ. Most of the ticket that the participants got was for speeding and they reported they got them because they were late for a professional appointment. .

Regarding the Violations scales from DBQ, participants had a very low mean score and it was expected a higher score than that founded in the DAX-BR validation study (Olandoski et al., 2017) since they are offenders drivers, but, in other side, is important to take into account that to do a violation doesn´t mean to receive a fine. Their mean was half of it was obtained in study 1. However, there are two possible reasons for this surprising finding. One reason are that some drivers, lost the right to drive and could have a long time that they do not drive, so they do not do more violations, and another possible reason is the highest median age of the participants. It is because with more age, less a person try to do a sensation-seeking behavior and, as a consequence, the person committed fewer violations (Bachoo et al., 2013).

Regarding the number of accidents in the last 5 years, the reported mean was below from other studies and even lower than that found by Olandoski et al. (2017) with a young student population. However there was a significant group difference for Verbal and Physical DAX-BR factor for both types of accident active and passive, similarly as it was founded out by Jovanovic et al. (2011).

Our results are different from those obtained with a population of young students, which commonly occurs in studies using DAX (Sullman et al.(2007); Villieux & Delhomme, 2008; Villieux & Delhomme, 2010; Sârbescu, 2012; Stephens & Sullman, (2014); Olandoski, et al, 2017).

This research has some methodological limitations. One of them is the use of a sample of drivers who have violated the rules and was punished because it. Then, it might have been a social desirability effect when answering the questionnaire. The responses to the questionnaire could have been influenced by the soft relationship of the studied population with factors such as anger while driving, for the punishment, experimented with risky behavior, the search for experience and behaviors of speed. However, the use of those instruments is relatively frequent in this area of research and many researchers have indicated significant positive relationships between statements of drivers and their actual behaviors while driving (Deffenbacher et al., 2001; Ferreira et al., 2009 Constantinou et al., 2011).

Another point, to change in further research, is to use a complementary survey for the types of fines and who is the responsible for it. Part of the participants were responsible for the fines, they got it because they are the owner of the car, the other part not. This is a Brazilian trouble since when the ticket is released the owner of the car can point out who is the responsible for that ticket, so it became a strategy for offender drivers to avoid losing their driver's license. This study may contribute information on the behavior and driving of this particular type of population and help in future studies on this topic.

Aggressive drivers are a significant and present reality in the population and it is necessary strategies to work with them. Angry drivers must unlearn to have hostile actions in general, for this, the use of cognitive therapy, associated with self-control strategies and relaxation are indicated (Deffenbacher et al., 2000; Deffenbacher, Oetting, & DiGiuseppe, 2002; Olandoski et al., 2017). The use of these strategies together with technology could be helping the authorities that regulate and supervise the traffic system to reduce accidentality.

7. Third Study: Eco-driving training

7.1 Introduction

Evidently, there has been a worldwide trend to reconcile socioeconomic development and protection of earth's ecosystems (Mensing et al., 2014). There is a growing concern, with questions related to the concentration of greenhouse gases (GHG) in the atmosphere and the emission of pollutants that tend to harm human health (Fernandes et al., 2015). Among them, the motorized transportation sector, which, compared to other economic activities in Brazil and the world, is responsible, respectively, for 9% (Brazil) and 13% (world) for GHG emissions (MMA, 2009 and IPCC, 2007).

The environmental dimension is increasingly becoming a problem that involves a set of actors in the educational world (Martin, 2013). It stimulates the involvement of the various systems of knowledge, professional training and university community in an interdisciplinary perspective (Jacobi, 2003). The degradation resulting from traffic to the environment is one of the major concerns. One way to reduce this impact for car-dependent drivers (Stradling, 2007) is to adopt eco-driving as a driving style (Martin, 2013). The strategy is to work out with all the internal resistance factors of the personality in drivers and their difficulty in dealing with emotional states in particular the aggression, which consequently creates environmental damages (Mensing et al., 2014).

The Information Technologies (IT) are applying their solutions to the motorized transportation and traffic sector, with this, helping to reduce the energy expenditure of cars and buses and consequently the pollution (Kurani et al., 2011). In the logistics sector, this technology helps to optimize travel routes to reduce traffic congestion through green wave signals, reduce the likelihood of an accident, and increase driver efficiency (Mensing et al., 2013). The use of these resources already presents practical results with shown by Nègre and Delhomme (2017) with the reduction of the atmospheric gases generated by the vehicles.

In recent years, greater attention has been given to driver training (Brasil, 2011), in particular to the effects of education, training and feedback on changing behavior. Different IT solutions, such as on-board computers are designed to help and guide the driver for more efficient driving behavior (Mensing et al., 2013). For this reason, the development of human-machine interface (HMI) in the cars is something promising. It provides relevant warnings in real time, which helps the driver of the car to adopt the eco-driving style and also reducing fuel consumption (Vaezipour, Rakotonirainy, Haworth & Delhomme, 2017). A better sense of driving behavior will help drivers not only know their vehicle better, drive safer, improve road safety, but also reduce fuel consumption and CO_2 emissions (Nunes et al., 2010). The use of electronics along with education, such as eco-driving can generate a feedback that will help the user understand the behaviors practiced and also know what aspects can be improved (Kurani et al., 2011). Therefore, results only occur when technology is associated with changing behavior (Rouzikhah et al., 2013).

The eco-driving idea is to reduce the environmental impact with a different driving style that tries to maintain a constant speed, anticipating the flow of traffic and accelerating and decelerating smoothly, doing it with less fuel consumption and consequently reducing CO_2 emissions (Dogan et al., 2011). The eco-driving is an easy way to generate financial savings and ecological preservation to the environment (Thijssen et al., 2014). However, to get those benefits, the driver has to counteract personal factors, especially aggressiveness, which can decrease their results (Thijssen et al., 2014).

According to Saboohi and Farzaneh (2009), the idea of eco-driving was introduced in 1993, in Germany. It was a combined initiative of the government, commercial and private firms to provide tips on eco-driving. For instance, the Dutch government launched a billboard and television campaigns to promote eco-driving (InstituutvoorDuurzameMobiliteit, 2012). There are studies on eco-driving in many countries such as Belgium (Beusen et al., 2009) and Canada (Rutty, Matthews, Andrey & Del Matto, 2013). France is also involved (Andrieu & Saint-Pierre, 2012), and Japan (Ando & Nishihori, 2011). Taiwan is engrossed in the category (Degraeuwe & Beusen, 2013). Lastly, we have the Netherlands (Dogan et al., 2011; Van der Voort, Dougherty & Maarseveen, 2001).

In Brazil, there are no studies with regular car drivers, only with drivers in heavy vehicles (bus or trucks) or financed by bank initiatives (Silva, 2007; Fernandes, Deveza & D'Agosto, 2012). Various laws advocate the eco-driving, but exists a lack of changes within the government and among the drivers. The Government focused on the use of alternative energy sources such alcohol and solar power. Evidently, the eco-driving in Brazil is tallying with the principles of Law No. 12.587 (National Policy on Urban Mobility). The core aim was to establish measures to manage anger among drivers by offering professional eco-driving education.

However, the authentic driving style required by the eco-driving must also balance with the management interactions with different types of road users and road safety (Dogan et al., 2011; Rouzikhah et al., 2013). Another key condition is assessing the driver's decision-making since driving is a dynamic activity. Drivers have to make decisions and execute them in real time in situations of emergency (Dogan et al., 2011). Furthermore, the internal factors are only part of which determines the potential change (Castro, 2009). Other factors such as the external constraints imposed by the time and the need to meet schedules; as well as having to follow a predetermined path can limit the ability of drivers to turn their eco-driving in a practical knowledge (Strömberg & Karisson, 2013). Hence, different road users must get familiar with the basic concepts outlined in the course under study.

According to Sivak (2012), traditional eco-driving is limited by the actions of drivers after purchasing the vehicle. It includes strategic decisions (such selection and maintenance of vehicles), tactical decisions (e.g. weight, route, vehicle type), and operational decisions. Conversely, the Driver behavior should improve vehicle fuel economy (Dogan et al., 2011; Sivak, 2012). Therefore, traditional eco-driving is fundamentally influenced by the strategic decisions outlined above.

Among the factors that affect the eco-driving are: a) selection of the class of the vehicle. b) Selection of the type of the vehicle; c) selection of the vehicle configuration, d) engine adjustment, e) type and pressure of tires, f) oil engine g) selection of the type of road. g) Selection of grade profile h) dealing with congestion. i) weight j) idle k) speed/RPM. Other factors include the use of cruise control, use of air conditioner; aggressive driving which showcases hasty brakes and rapid acceleration of the car (Rouzikhah et al., 2013).

Therefore, integrating the biological, social and behavioral factors in this perspective implies being able to explore the subjective position of drivers, with their personal assessments, personalities, psychological motivations and psychological barriers and behaviors to reduce the impact of aggressiveness and ensure sustainable eco-driving Fernandes (2013). Due to its green, social and sustainable features, as well as the eco-driving style based on anticipation on what can happen in the driving environment, and the adoption of soft accelerations and soft decorations, this driving style can lead drivers to behave in a friendly way to improve current traffic problems (drive aggressively) (Ueba et al., 2010).

Furthermore, Fernandes (2013) suggested motivating the drivers to start new behaviors that encourage safe driving and calmness.

As recommended by Gold (2003), the damage brought about by aggression on the roads can be limited by emphasizing an eco-driving culture that encourages drivers to adopt more settled and reasonable reactions while on the road. Stress reduction among drivers can also go a long way in ensuring the drivers are composed and adhere to the stipulated laws and regulations (Cuffa, 2016).

The aggressiveness of the driver is the greatest difficulty and most challenging to maintain during the implementation of eco-driving behaviors (Fernandes et al., 2012). Thus, drivers expect to have enough time and space to anticipate and respond to risks in a road environment (Regan et al., 2011). For these authors, time pressure can lead drivers to reduce their safety margins, commit violations such as increase speed (Dogan et al, 2011). Therefore, drivers can be satisfied with their performance regarding safety as long as they reach their destination alive, unharmed and without incident (Fernandes et al., 2012).

If a driver has a deviation from the anticipated situation and therefore the habitual behavior, drivers tend to take action to avoid negative consequences (Summala, 2007; Saad, 2002). Shift between the goals and take further regulatory actions based on the mental representations of the situation in order to maintain control over their vehicle and preferably return to a more typical automated effortless driving style (cf. Brehmer, 1992), and it means to return to certain aggressive behaviors such quickly breaks and quickly accelerations.

In a test conducted by Edmunds (2005), a form of controlled driving produced, on average, 31% less fuel consumption than aggressive driving. LeBlanc et al. (2010) have found that in the normal form of a driver without the time pressure that, for both the roll speed and the necessary acceleration of letting the rest inertia, drivers with an eco-driving mode using the same vehicle that aggressive drivers experienced fewer than 20% difference in fuel consumption.

About 40 years ago, aggressive driving was identified as a significant traffic safety problem (Sarbesc, Stanojevic & Jovanovic, 2014). However, only in the last two decades, the issue of aggressive driving has escalated and now it is considered as a global problem (Sarbesc, Stanojevic & Jovanovic, 2014; Sullman, 2015).

Aggressive driving contributes in part to one third of bodily injury and two thirds of all road traffic fatalities, resulting in 56% of fatal accidents occurring between 2003 and 2007 in Serbia. Drive anger is an import factor and eco-driving style would help to minimize it (Sarbesc, Stanojevic & Jovanovic, 2014).

Anger is an emotion commonly, experienced while driving (Underwood et al., 1999). Individuals are more likely to experience anger while driving than in any other situation. However, people who experience high levels of violence in other cases have higher chances to be angry while driving (Lawton & Nutter, 2002; Sullman, 2015).

Additionally, the anger while driving was associated with accidents (Deffenbacher et al., 2001b; Maxwell et al., 2005; Parker et al., 2002; Underwood et al., 1999; Sullman, 2006; Sullman et al., 2007; Sullman & Stephens, 2013; Sullman, 2015). Another reason for the growing popularity of this threat is the tendency of angry drivers to engage more often in harsh and dangerous driving behaviors (Stephens & Groeger, 2011; Sullman, 2015). Notably, it endangers other drivers (Deffenbacher et al., 1994; Deffenbacher et al., 2001b; Lajunen et al., 1998; Maxwell et al., 2005; Underwood et al., 1999). Links existed between driving anger and conditions of accidents and are positively related to speeding, violations, and sensation driving (Deffenbacher et al., 2001b; Deffenbacher et al., 2003a; Deffenbacher et al., 2003b; Sullman et al., 2013; Sullman, 2015; Olandoski et al., 2017).

Studies conducted on this topic provide insightful facts on the expression of inventory driving (Deffenbacher et al., 2002). It is commonly referred as the DAX and has been embraced in various countries. They include France, Romania, Serbia, Spain, Turkey, the US. Others are England, New Zealand, Malaysia and Brazil (Olandoski et al., 2017; Villieux & Delhomme, 2010; Sarbescu, 2012; Jovanovi'c et al., 2011; Herrero-Fernández, 2011; Stephens & Sullman, 2014; Sullman, 2015; Sullman et al, 2015). Evidently, to establish the facts, a Driver Behavior Questionnaire was used (DBQ). DBQ can be described as a detailed and authentic report that the magnitude of the risk behaviors. A particular and definite relation between the anger unlegagesashed when driving, and the factors contained in the DBQ were explained in various literature reviews (Baron & Richardson, 1994; Berkowitz, 1993; Coie& Dodge, 2000; Jovanovic et al., 2011). Lastly, the DBQ was tested for 20 years and during this period various cases showcased as a proof of the scientific process.

It is notable that aggressive driving is engrossed in a personality of an individual. Evidently, each human being has a unique personality which prompts different behaviors when subjected to certain situations. For instance, a driver who upholds an aggressive driving style will risk when driving and hence resulting in accidents (Bachoo, Bhagwan Shee & Govender, 2013; Stephens & Sullman, 2015). According to Stephens and Sullman (2015), that irrational behaviors, that is to say aggressive behaviours, lead drivers to causing accidents through rude behaviors such as speeding, violating traffic laws and negligence of complying with road signs.

In as much as the validity to assess the personality exists and mostly when evaluating road users, the legality and attention provided, are paramount. According to Taubman et al.

(1996), they designed a system to train drivers to focus more on making the road a safe place for themselves and other civilians. The program which they created, triggers the users to ensure extra safety precautions such that personality traits are embraced harmoniously.

The eco-driving mode structured in its environmental concern, but for it to be effective, it requires the behavioral and cognitive change of the drivers. This paper proposes to test the hypothesis that the eco-driving training will lead to a reduction of the fuel to run a determined distance. The operational goal of this third study was to train 10 drivers comprising The Maintenance and Services Company in the city of Curitiba to attain an eco-driving profile.

In the behavioral aspects, the hypotheses tested were that the occurrence of the impact of aggressive behaviors in the drivers should decrease. The planning of the destination routes with the aid of electronic equipment such as GPS supported the eco-driving behaviors. Lastly, a decline in the behavior of errors and violations of drivers due to increased awareness.

7.2 Method

7.2.1 Participants

Ten drivers (100% men) were selected through volunteering from two different departments of a company of maintenance of traffic lights and buses of the City of Curitiba. Participants drive the same service car in their work. Five drivers come from each department. The mean age of participants was 34.40 years old (SD=7.90 range=26 to 50), of which 10% had completed elementary school, 50% completed high school, 10% had incomplete college and 30% had a college degree. The participants had their driver's license for a mean of 15.60

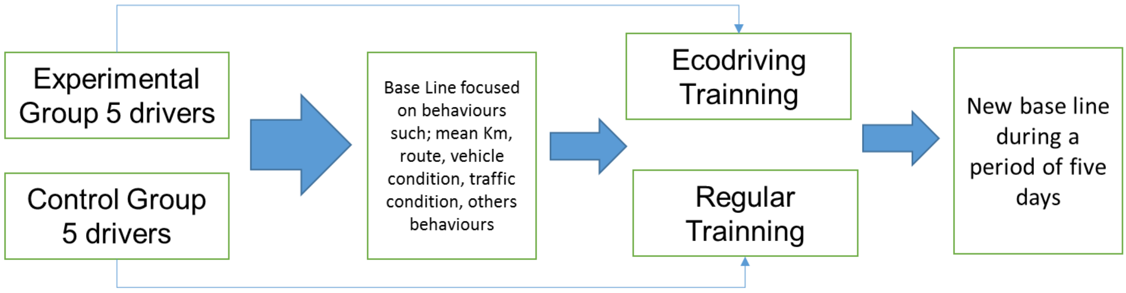
years old (SD=8.06, rage= 6 to 34), and reported driving a mean of 13000 Km per year (SD= 5000 km). In the sample, 60% of drivers drove six days a week and the others drove every day. Three drivers had reported passive accidents with minor damage, and two reported active accidents with injured people, while two drivers from the control group reported a passive accident of great damage.

Additionally for the survey for the last five years, 60% of the total of the participants were fined for speeding (30% from each group), 20% for driving while talking on a cell phone (from the experimental group and 20% for crossing a red light (from the experimental group). The remaining 10% were fined for stopping in a forbidden place (from the experimental group).

7.2.2 Procedure

The procedure used was a longitudinal study comprising two groups: the experimental group for the intervention, and the control group. Five drivers were designed in each group. The drivers in the experimental group were selected from the traffic lights maintenance drivers because they usually drive heavy load vehicles and heavy cars (see Figure 1). Whereas the drivers in the control group were selected from maintenance of the buses' drivers. All drivers work in different time scales, so they even know each other. The drivers to experimental group were selected from the traffic lights maintenance drivers because they usually drive heavy load vehicles and heavy cars. The drivers to control group were selected from maintenance of the buses' drivers.

Figure 1: Eco-driving structure training.



There were 5-day periods of data collection for the ten drivers when were collected the baseline parameters (clime, distance, traffic conditions, sudden brakes, quickly speed up).

Before starting the experiments and training, all cars were reviewed for optimal performance (tire pressure, mechanical repairs). Once these conditions were ascertained, participants drove a trial route for five days in the city, as a baseline. The experimental group had in the baseline a medium of 10.98 Km per liter, 1.8 times that they sudden brakes and 1.6 times that they quickly speed up. The control group in the baseline had a means of 10.26 Km per liter and 0.4 times that they quickly speed up and 0.1 times that they sudden brakes. Since both groups of drivers drove in similar conditions and did almost the same daily drive distance in the same city, factors such as car weight, quick brakes, climate, traffic flow, temperature and other minor factors that affected fuel consumption could be not considered.

The next step was the intervention. All drivers, in the experimental group and in the control group, received individual eight hours entrainment since they work on a scale hour system. In the experimental group (eco-driving), the training was focused on the strategies to avoid heavy braking and sudden accelerations, how to take decision to avoid traffic flow and the idea to drive on a constant speed. Also, it was read a text together with each participant including information stating that the aim of the study was to find out the minimum amount of fuel required to complete the trips and it was possible to reduce fuel consumption when an eco-driving style was adopted. In the control group, the training was focused on a safety drive, how to reduce accidents, how to drive with cyclist and motorcycle drivers, how to act in an accident situation. After the data collection, the control group received the eco-driving training too.

In the next step (retest) participants drove another trial route for five days in the city with the same car as they drove before. All the car conditions were checked again for optimal performance (tire pressure, mechanical repairs). Once these conditions were ascertained, participants of the two groups, drove a trial route for five days in the city, for collection of data for the experiment. Once the experimental driving was over, participants answered the survey.

Finally, participants completed these five measures, after the second data collection, in this sequence: DAX-BR, Hostility Scale, DBQ, DSSS and, the socio-demographic information in a single section. Also, it was assured that the answers would be treated with strict confidentiality and anonymity attending ethical procedures. The entire process took less than 20 minutes to complete.

7.3 Training Course

It was followed the schedule with the number of the days and the activity that was done in each training driver (sse table 15). It was an eight-hour course.

Table 15: Training Course

Course day	Activity
1	What is eco-driving, how it works; the benefits and difficulties. Several questions were answered.

2	Information about quickly Speed up; when change the gear and how to use the Baggage.
3	Focused in braking; Anticipation of Itinerary; Air conditioning use and how to Speed control
4	Time pressure, strategy to avoid it, and psychology pressure and how to use better electronic resources.
5	Review with the driver all the training steps and to take out any doubt.

In the control group, talking for eight hours about how to drive safely and discuss the problems with the traffic as how to reduce accidents, how to drive with cyclist and motorcycle drivers, how to act in an accident situation.

7.4 Measures

(1) The Brazilian Driving Anger Expression Inventory (DAX-BR) used in the previous studies. Participants rated items on a 4-point scale (1='almost never' to 4='almost always') according to the degree to which they express their anger while driving in the manner described in the item. DAX Brazilian version has satisfactory reliability scores for the total scale (α=.89).

(2) The Brazilian adaptation of the unifactorial Hostility Scale, used in previous studies. The scale has 8 items rated on a 5-point scale (1='not at all' to 5='very much'). Hostility Brazilian version had a good reliability scores for the total scale (α=.86).

(3) The 28 items Driver Behaviour Questionnaire –DBQ (Reason et al., 1990) adapted to use in Brazil by Bianchi and Summala (2002) divided into four factors: Errors, Aggressive Violations, Ordinary Violations and Lapses with a range rated items on a 6-point scale (0 = 'never' to 5 = 'always'). It was used Errors, Ordinary Violations and Aggressive Violation factors in this study. At the end of DBQ, two new questions referring to Aggressive Violations factor were included: "Driving too close to the car in front with the intention to go

faster or get out of his way" and "Getting angry at a certain type of driver and show it.” Then, the final DBQ was a 30-item questionnaire.

(4) The unifactorial Driving Sensation Seeking Scale - DSSS (Taubman et al., 1996), used in the previous studies. The scale contains 7 items rated items on a 4-point scale (1= "never” to 4= “always”). DSSS Brazilian version has low reliability scores for the total scale (α=.60).

(5) Socio-demographic data were registered on age, kilometers driven since receiving a driver's license and the year of license, school graduation level, the types of accidents as a driver and number of fines received in the last five years, as well as the maximum speed that drivers drive on various road types: main roads, on dual carriageways, in town centers and country roads.

7.5 Data analysis procedure

A training study was carried out using an experimental design which basically consists of (1) a pre-test, which aims to investigate the initial notions or basic lines of each driver; (2) a training situation, where specific instructions and explanations were given to subjects on a particular concept; and (3) a post-test (that the same parameters were collected from the pretest), which aimed to examine the notions presented by the subjects after the experimental intervention. The pre- and post tests were applied to all subjects of the sample, whereas the training situation was applied only to the experimental group. The existence of a control group was adopted and received safety procedure training. The experimental group was one whose subjects received training and specific instructions about the concept of eco-driving.

In terms of data analysis, the investigation included comparisons that occur in two directions. A horizontal analysis, in which the performance in the pretest was analyzed, in the case of investigating differences of the profile of the groups and (2) the performance in the post-test between the control and experimental groups. Another analysis - vertical - that compares the performance between pre- and post-test in each subject group (control and experimental). The purpose of the first analysis was to examine whether subjects (depending on certain characteristics such as age, schooling, social class, etc.) present different levels of understanding of the concept in question. The second analysis, in turn, was to examine whether there are differences between the results of fuel consumption, climate, traffic conditions, sudden braking and acceleration, car weight, route selection (by GPS use or mental form) in the pre- and in the post-test and whether these differences can in fact be attributed to the intervention performed. This vertical analysis also offers an understanding about what type of knowledge or initial notion the subject needs to present in order for a type of intervention to be successful.

7.6 Results

The first part of the results will focus on the eco-driving experimental according to that point: if the driver used the mental criteria or GPS use to choose the route; climate conditions; rapid acceleration and quick braking; whether or not the vehicle was loaded; quantity of liters per kilometer.

After comparing the baseline and post-training information, and the results of the intervention and control groups, it was possible to know if the training was effective. It was assumed as criteria that a 5% reduction in fuel consumption was significant. It was analyzed the behavior of these drivers to aggressive behaviors and personality factors (see above the measures section). The size of the effect evaluated with Cohen's d, where 0.2 interpreted as small, 0.5 as medium and 0.8 as large effect size.

Results for accidents were separated into, active accidents (when the driver causes an accident) and passive accidents (when the driver is involuntarily involved in an accident).

The table 16 presents at which frequency participants per group reported exceeding speed limits on different types of roads.

Table 16: Frequency of exceeding speed limits on different roads types

Frequency/ Place	town center	main roads	dual carriageway	country road
always (control Group)*	1	1	1	1
always (experimental Group)	0	1	0	0
sometimes (control Group)	2	2	1	0
sometimes (experimental Group)	3	2	1	1
rarely (control Group)	1	2	3	3
rarely (experimental Group)	2	2	3	3
never do it (control Group)	1	0	0	1
never do it (experimental group)	0	0	1	1

*Each group has five participants

The main places that the drivers of both groups tend to speed are in Town Center and on Main roads.

When asked how often they drive above the speed limit in the town center, for the total of the participants 10% always have this behavior (all in the control group), 50% do it sometimes (two from the control group and three from the experimental group), 30% rarely do it (one from control group and two from the experimental group), and 10% never do it (

one from control group). For speeding on main roads, 20% of drivers said they always exceed the speed (one participant from each group), 40% sometimes do it (one from control group and two from the experimental group), 40% rarely do so (two participants from each group). . For speeding on dual carriageways, 10% of drivers said they always exceed the speed (one from control group), 20% sometimes do it (one from each group), 60% rarely do it (three from each group), and 10% never do it (from the experimental group). For speeding on the country road, 10% of drivers said they always exceed the speed (one participant from the control group), 10% sometimes do it (from the experimental group), 70% rarely do it (three from the control group and four from the experimental group), and 10% never do it (from the experimental group). The reasons for exceeding the speed were 20% to save time (one from each group), 60% to arrive on time (three from each group), 10% say it is to show skill (from the experimental group) and 10% for pleasure (from the control group).

The Table 17 is divided into a part that sets the results of the baseline and a part that sets the results after training. Also, they are included in the parameters of acceleration and braking and use or nonuse of GPS to plot the car's route. The fact that the work car is loaded also influences Km/liter ratio. The first five drivers are experimental participants and passed the eco-driving training, while the other five are drivers from the control group. Note the use of mental routes and the presence of abrupt brakings and accelerations at the baseline.

Table 17 : Results for Base line and after Training

	Baseline									After Training			
Typeo of the Group	Name	Traffic Conditions*	Weather**	Car Weight***	Number of times Speed Acceleration	Number of times Break Quickly	Medium Km/L	Traffic Conditions	Car Weight	Weather	Number of times Speed Acceleration	Number of times Break Quickly	Medium Km/L
Experimental group	Driver 1	Normal	Sunny	Normal	0	3	12,04	Normal	Normal	Cold	0	0	12,93
	Driver 2	Normal	Sunny	Normal	2	2	9,58	Normal	Normal	Cold	0	0	10,68
	Driver 3	Normal	Sunny	Light	2	2	10,76	Normal	Normal	Cold	0	0	11,98
	Driver 4	Normal	Sunny	Normal	2	0	12,31	Normal	Normal	Cold	0	0	13,65
	Driver 5	Normal	Sunny	Normal	2	2	10,19	Normal	Normal	Cold	0	0	11,79
Control Group	Driver6	Calm	Sunny	Light	0	0	11,92	Calm	Normal	Cold	2	0	11,93
	Driver7	Normal	Sunny	Heavy	0	0	8,65	Normal	Normal	Cold	0	2	8,65
	Driver8	Normal	Cold	Normal	0	0	10,46	Normal	Normal	Cold	2	0	10,67
	Driver9	Normal	Sunny	Normal	0	2	10	Normal	Normal	Cold	0	0	10
	Driver 10	Normal	Sunny	Normal	0	0	10,29	Normal	Normal	Cold	2	0	10,33

* A normal traffic Conditional was embraced when you have traffic close to the lights/ A calm situation existed among fewer cars on the streets.

** For the weather, a sunny day in the city is around 22 to 28 Celsius degrees.

**** On the weight, a typical situation with identical parts and tools for normal circumstances. Also, a heavy car is when they merged metal parts reposition and a light situation when they just took a board reposition.*

In the baseline, both groups used memory to get to the destinies and the experimental group in the second data collection used GPS, and the control group keeps the mental route to arrive at the destinies.

As the results, the experimental group had a medium of 12.20 Km per liter and they did not have any heavy brake or sudden accelerations. The control group had a medium of 10.32 Km per liter and had a medium of 1.2 sudden accelerations and 0.4 heavy brakes. The experimental group reduced the cars fuel consumption at 11.11% and avoided the sudden accelerations and heavy brake behaviours. The control group keeps all the same behaviours as they had in the baseline. Participants were instructed to keep to the speed limits and obey all of the traffic rules and traffic signs for both the data collection.

Comparing the baseline consumption of gas with the experiment consumption of gas, there was a decrease of 11.34% in Km/liter ratio, and a total reduction in speed acceleration and braking for the experimental group drivers. For the control group, there was a decrease of only 0.05% in the consumption of gas and an improving of 1.2 mean times in the speed accelerations.

7.6.1 DAX-BR

The DAX-BR items number 30, 49, 23, 29, 36 and 42 had the highest mean.

In table 18 are presented to the means and SD of each DAX-BR factor.

Table 18: Means and standard deviations of the DAX-BR

Fator*	Total sample Mean	SD	Control Group Mean	SD	Experimental group Mean	SD
Use of the Vehicle to Express Anger	1.37	0.35	1.40	0.23	1.33	0.47
Personal Physical Aggressive Expression	1.15	0.25	1.12	0.10	1.18	0.36
Verbal Aggressive Expression	1.67	0.39	1.70	0.39	1.65	0.27
Adaptive/Constructive Expression	2.63	0.73	2.55	0.46	2.71	0.97

*4-point scale (1='almost never' to 4='almost always')

The adaptive/Construction factor had the highest mean, while the Personal Physical Aggressive Expression had the lowest mean. There was no significant difference between the control group and the experimental group. For the adaptive/Constructive Expression the Experimental group had the highest mean and for the personal Physical Aggressive. The total result means are closed to what was founded in the second study.

7.6.2 DBQ Scale

The DBQ measures four types of behaviors, but in this study we had only used three factors: Errors (stock failures planned in search of unintended results, including observation and judgment of action flaws), Ordinary Violations (disrespect deliberate to traffic laws) and Aggressive Violations (acts of hostility towards other participants of traffic), see. Table 19.

Table 19: Means and standard deviations of the DBQ

Factor*	Mean	SD	Control Group Mean	SD	Experimental group Mean	SD
Ordinary Violations	0,54	0,52	0.56	0.54	0.52	0.50
Aggressive Violations	0,47	0,48	0.49	0.49	0.45	0.45
Errors	0.32	0.30	0.31	0.30	0.33	0.30

*Scales from 0 behavior frequency score for "never" to 5 for "almost always".

The ordinary Violations had the highest mean,while the error was the lowest mean. There was no significative means group difference between control group and experimental group. All three factors means are lower than was found it on the second study.

7.6.3 DSSS

DSSS is a unifactorial scale with 1 to 4 points. It was obtained a general means of (M=0.31, SD=0.28). With the experimental group (M=0.31, SD=0.28) and the control group (M=0.27, 0.18) Item number 1 had the highest means of the sample (M=0.9, SD=1.1). There was not any significant difference between groups on the DSSS.

7.6.4 Hostility Scale

The mean was (2.12 points SD = 0.70). For the experimental group it was (2.15 points SD = 0.74) and for the control group it was (2.10 poets SD=0.75) Item 7 showed the highest result (M = 3.10, SD = 1.20), followed by the number 2 (M = 2.40, SD = 0.97). These results are similar to that obtained by Delhomme and Villieux (2008) and in the first study. For the DAX-BR there was not any significative mean group difference. However, the control group had a higher Adaptive and Constructive factor mean, while the experimental group had a higher Verbal Aggressive factor mean. For the DBQ was not any significative mean group difference, but the control group had a higher mean in the aggressive violations and errors.

For Hostility scale the control group had the highest mean, while for the DSSS the experimental group had the highest mean. The scores in DAX-BR and in DBQ were lower than in the previous studies.

7.6.5 Correlations between DAX-BR, Hostility Scale, DBQ and DSSS

Table 20: Correlations between factors

Factors	1	2	3	4	Hostility	DSSS	Errors (DBQ)	Ordinary Violations (DBQ)	Agressive Violations (DBQ)
1-Verbal Aggressive Expression		0.22	0.55	-0.05	0.57	0.35	0.72*	0.70*	0.58
2-Personal Physical Aggressive Expression			0.78**	0.16	0.36	0.46	0.75*	0.18	0.06
3-Use of the Vehicle to Express Anger				0.07	0.56	0.56	0.83**	0.37	0.23
4- Adaptive/Constructive Expression					0.49	0.13	0.01	0	-0.16
5-Hostility						0.33	0.54	0.62	0.24
6-DSSS							0.71*	0.14	0.28
7-Errors								0.4	0.33
8-Ordinary Violation									0.66*

**. Correlationissignificantatthe 0.01 level (2-tailed).

*. Correlationissignificantatthe 0.05 level (2-tailed).

The Verbal Aggressive Expression had a large positive correlation with all DBQ factors and with Hostility and DSSS.

7.7 Discussion

The aim of this study was a new training in Brazil for daily professional car drivers focused on eco-driving.

There were positive results, especially in Kilometers ratio wheeled cars per liter. This improvement or decrease in fuel consumption could have been better if these drivers do not often have the time pressure because sometimes the drivers have 30-minute limit to answer a problem in the City. Besides, it became obvious that the use of GPS helped improve the car consumption ratio, because it focused on optimizing routes with better traffic flow, avoiding situations of acceleration and braking. The use of GPS can be better use as a tool for improving the way of drivers thinks about their routes and change their cognitive way of think, since it was clear that they used very consistently these tools and got adopted in the way it works.

The use of the technology can be an important support to the driver behavior on an eco-driving way. As said (Kurani et al., 2011; Mensing et al., 2014; Vaezipour, Rakotonirainy, Haworth & Delhomme, 2017).

Still a good result of 11.34% of the decrease in fuel consumption; it is vital to point out that the drive could change behavior in a more controlled way because they could think they were observed and also to give a social expect answers.

As for the control group remained that they got the same ratio of consumer kilometers per liter of fuel in both baselines; An important issue is that at the time of the year that the data collection was done there was a change of time, through the heat to cooler temperatures, causing walked drivers with the windows closed, which contributes to the improvement of the relationship fuel per kilometer driven.

The results could have been better if these drivers do not receive constant training for defensive driving and if they were not responsible for the costs of a possible strike. In a way, the drivers already follow some eco-driving rules, such seeping and to keep a distance from the car ahead not to decrease the speed very quickly or change the gear. Still an important point that shows the improvement in the conduct of drivers is to reduce breakers and accelerations in the training group.

Driving anger can be expressed by drivers in a high relatively frequency on the roads as it has adverse effects to eco-driving (Nègre & Delhomme, 2017). These behaviors can be per e.g. sudden deceleration or acceleration. Trait anger refers to a propensity to become irritated while driving (Deffenbacher et al., 1994). Anger can interfere with eco-driving by leading drivers with angry traits to use more fuel, polluted more and be noisier (Nègre & Delhomme, 2017).

In this study the experimental group after the training had any aggressiveness behavior as quickly stopped, quickly brake or sudden acceleration, while the control group almost keep the same base line behaviours.

Another point of the study was to use the adaptation of the Brazilian scale DAX work with an unusual population of traffic psychology, the offenders' drivers. Besides, to establish relationships with risk behavior, search for sensations, violation, and speed as well as traffic violations.

We found the same structure as the DAX-BR developed in study 1 on this sample. This finding is in favor of the reliability of this instrument. However, regarding the correlations, the DAX-BR Verbal Aggressive Expression had medium and large size effect with all the DBQ Factors what was different from the first study. The positive correlations with DSSS, different from Delhomme et al. (2012) and Hostility scale.

On the scales of the DSSS and Hostilty, the score obtained was lower than in study 1 maybe because the sample is older and smaller.

For the DBQ results, they were much lower when compared with Resende (2015). As for the accidents, the reported mean was below that Resende (2015) and study 1 with a young student population.

This research has some methodological limitations. One is the use of a small sample, and the few weeks to keep following the driver’s behaviours, to know if they keep the new behavior. Other it was the opportunity to answer the questionnaire and direct according to social desirability. The responses to the survey could have influenced to soften the relationship between the studied population with factors such as anger while driving, for the wrongs suffered, to experiment with risky behavior, the search for experience and practices of speed.

However, the use of those instruments is relatively frequent in this area of research, and many researchers have indicated significant positive relationships between statements of drivers and their actual behaviors while driving. Results collected are different from those obtained with a population of young students, which commonly occurs in studies using DAX such (Villieux & Delhomme, 2008; Villieux & Delhomme, 2010; Sârbescu, 2012; Olandoski, et al., 2017). The second limitation is the use of questionnaires to collect data and non-electronic equipment, despite the error checking and doubts surveyed.

The contribution of this study is to awaken new companies adopt this mode of direction for its employees since it brings many benefits for both the company and for the environment.

It is important to maintain the training done so that drivers do not fall into old habits or addictions that can harm done training.

8. General Discussion and conclusion

1. Introduction

Aggressive driving is a big concern to traffic safety in the world, in general, as it represents a great risk of car accidents, resulting in problems for the victims, for your families and for the governments. In Brazil it is not different. This call for research that can be mitigated to such impacts. However, a more effective way of doing this is still far, since the country focuses its resources on television campaigns (Brasil, 2015) and changes in the Brazilian traffic code since it was created in 1997. These strategies are not enough to give solutions to such a major problem, and that can be observed from the last WHO report (2015) where the accidents curve to Brazil is increasing, despite the compromise signed by countries in UN to reduce in 50% of the traffic accidents until 2020. The general aim of this thesis was to study the role of aggressiveness in road traffic in Brazil and to examine how combined efforts can reduce its impact while improving road safety and mobility.

James and Nahl (2000) noted that the impairment in drivers' emotion can lead to a type of behavior that observers can consider as aggressive. Normally, factors such as impatience and inattention produce risky or dangerous actions which may lay a notion of aggression such as sewing through the lanes, speeding, and run red lights. Aggressive actions such as swearing, yelling, and tailgating can represent aggressive act to another driver. Lawton et al. (1997) suggested that in the traffic there are violations that involve the act of aggression directed to other drivers just to attack. Sometimes they are not traffic Code Violations and they are not related to risk driving. Otherwise, there are aggressive driving behaviors, as speeding in the calm zone that is aggressive in the act, but not in the objective. To Lawton et al. (1997) they are Ordinary Violations. In the same sense, Tasca (2000) noted that some risky actions such as running stop signs and using shoulders to pass cannot be equated to display of hostility such as horns honking, yelling at other drivers and making obscene gestures.

Therefore, in this study, it was hypothesized that, in addition to the external factors such as specific conditions around driving, which include the physical environmental conditions (such as cities that have good or bad road conditions, temperature, and signaling), contextual situations (such as being in a hurry and being in a traffic jam), traffic engineering (such as the green wave effect and speed cameras control), and social dimensions (such as interaction with the people around, and pressure), the driver personality and emotional states are a big issue for the accidents.

Driving is also influenced by personality characteristics (such as getting angry easily, how to react in different situations, how motorists accept the rules and sensation seeking) as well as psychological factors (such as representations, motivations and emotional states). Generally, most research that has been done on these phenomena have surrounded by examining two variables; the personal level and the sociocultural level.

According to Mizell (1997) road rage is considered as an act aggressive driving whereby an angry drive can cause damage to another driver or pedestrian, it is different of aggressive driving (Nerenberg, 1997). In road rage, a driver can drive safely but make an obscene gesture while, on the other hand, aggressive driving is defined as the actual driving behaviour. Because the difference between terms NHTSA (2000) in order to avoid conflicts with any term of road rage determines that officers should be trained to use the appropriate terminologies when conducting their activities at traffic stops and in the opportunities involved with public information. In the same context it is not only the number of transgressions that differentiate “road ragers” from “aggressive drivers.” A study by NHTSA

(1999) came up with findings that aggressive drivers in relation to public safety campaign were more aware of the safety task than general drivers.

This thesis focused on two research questions related to drivers. The first one was about the personality factors, the role of aggressiveness in road traffic in Brazil and to examine how combined efforts can reduce its impact to improve road safety and mobility. The second question was about the factors related to the driver's behavior that could lead to the reduction of the impact of aggressiveness while driving.

Most of research in a large extend focused on the socio-cultural and personal level variables ignoring the cognitive, emotional and aggressive behaviors related to if interventions and campaigns want to work on this behavior, then there should be an approximation to the psychology knowledge. Research has established that emotional states such as anger, stress, anxiety, aggression and anguish among others greatly increase the likelihood of risk behavior and accidents. All these emotional conditions are associated with personality (Treat et al., 1977). The perceived aggression by the drivers and how to deal with were the hardest part of this work. At least as drivers in many countries, the Brazilian drivers do not change their behavior in an easy way (Cannel, 2001; Cupolillo, 2006; Caixeta et al., 2010). Although the growing numbers of accidents and deaths, there is a strong resistance to change any kind of behavior (Constantinou et al., 2011).

To answer these two research questions, three studies were carried out in Brazil in order to identify aggressiveness behavior (from a personality trait or an emotional state) in different types of daily situations in the traffic context. This general discussion begins with a short summary of the main results; afterwards we will discuss the implications for the theoretical framework and for the society. A number of limitations of our studies will be addressed at the end of this chapter and we will expose the perspectives for future research.

2. Summary of results

In general, adoption of techniques and policies especially in different countries of their origin is prone to challenges. For instance, there are the language difference context, the different social habits, and the social norms, as well as what is deemed correct or incorrect when implementing new instruments.

Pasquali (1999) pointed out the lack of psychometric scales in Brazil constitutes deficiency and barriers to scientific research advancement. When using scales developed in foreign countries methodological difficulties are not negligible, such as obtaining samples, translation, context and non-existence of tests and retests. In addition, other authors contributed to this argument (Garcia, 1985; Jackson & Warr, 1984; Stafford, Jackson & Banks, 1980; Álvaro-Estramiana, 1992; García-Rodriguez, 1993).

First Study

The aim of the first study was the adaptation of the DAX scale, of the Hostility Scale and of the Driving Sensation Seeking Scale to Brazilian context. The participants were 512 young drivers, all of them undergraduate students (with a mean age of 23.78 years, 52.1% of men). The study sought to identify if the structure of the adapted scales were the same as the original scales and also if the instruments were reliable. Additionally, it aimed to identify whether there were any significant group differences according accidents (active or passive, to have or not to have), gender and fines (to have or not to have) in different instruments. Also, it was checked if DAX-BR works as a good predictor for violations, errors, accidents or fines.

It was expected that more impacting results would be found on the first study of DAX-BR scale, but as it happened in other countries, DAX-BR suffered several changes and items number reductions. In the adaptation of the DAX-BR, we founded a high reliability as represented by Cronbach´s alpha that was considerably good. To get a better structure, several items were deleted beyond the expectations. In the first study, it was surprising that to younger drivers' "Adaptive/Constructive Expression" factor got the highest mean, we are waiting for the "Use of Vehicle to Express Anger" or the "Personal Physical Aggressive Expression" factors to get the highest mean, but the results indicated the lowest figures. It was also expected that there was a significant difference according to gender in all the DAX-BR factors but only to the "Adaptive/Constructive Expression" factor this difference was significant: men tend to be more aggressive than women.

When we distinguished active and passive types of accidents, only for the active types of accidents (to have or not to have), there were significant group differences in all DAX-BR's factors. In those cases, the group that done the accident had the highest mean, just for the Verbal Aggressive Expression factor the group that suffered the accident had the highest mean. On the other hand, for the passive accidents, significant group differences were not expected as in this case the driver only faced action. However, for passive accidents there were significant means difference to "Verbal Aggressive Expression" and "Use of the Vehicle to Express Anger" in both cases, the group that suffered the accident had the highest mean.

With reference to fines, significant mean group differences for all the DAX-BR's factors were expected, but we only find them in the Personal Physical Aggressive Expression, and in the Use of the Vehicle to Express Anger, for both of them the group that received the fines had the highest mean.

As per gender, it was surprisingly found out that there were significant group differences for Ordinary Violation and not for Aggressive Violations, since men tend to be more aggressive than women (Veiga et al., 2009; Bener et al., 2008, Shi et al., 2010; Winter

& Dodou, 2010). Otherwise, for active accidents, there were significant means difference to Ordinary Violations, Aggressive Violations and Errors' factors, and the group that had involved into an accident had the highest means. On the other hand, the means difference for the passive accidents was significant for both types of Violations (Ordinary and aggressive) and in those cases the group that had suffered an accident had the highest means.

As for fines there were significant group means differences to Ordinary Violations and to Aggressive Violations, and in both cases the group that had received fines had the highest means. It was something that we expected because to receive fines the driver should have done traffic violations.

Ideally, to the Hostility Scale we waited a better Cronbach´s alpha, higher than 0.70 to a good reliability, but it was 0.61. It did not have major issues in the adaptation of the Brazilian context since it is a unifactorial scale. Additionally, it was surprising that there was not significant differences according to gender on the Hostility Scale, since men tend to have more Hostility than women (Perepjolkina & Renge, 2011; Sârbescu et al., 2014).

Furthermore, Driving Sensation Seeking Scale (DSSS) got a good reliability with Cronbach´s alpha of 0.86 and all the group means difference that was expected to occur (gender, accidents and fines). About gender differences, men have a higher mean, because they tend to seek more sensations (Zuckerman & Kuhlman, 2000). For active accidents, because a higher Sensation Seeker tends to be more frequently involved into an accident (Peer & Rosenbloom, 2013; Zuckerman, 1994). Finally, for fines, because in the literature sensation seekers receive more traffic tickets for speeding than other groups (Cestac et al., 2011; Jonah, 1997).

It was expected that significant large positive correlations between DAX-BR's factors and all the other instruments would be observed but they only happened with DAX-BR' "Verbal Aggressive Expression," Hostility Scale and DBQ's Ordinary Violations and Aggressive Violations. In opposite, the DAX-BR's factor "Use the Vehicle to Express Anger" had a negative medium correlation with Hostility Scale, DSSS and DBQ's scales.

For DBQ it was expected and it was corroborated that DAX-BR would be a strong predictor for DBQ since DBQ factors (Ordinary and Aggressive Violations) describe violation behaviors. For the fines and accidents, DAX-BR did not work as a reliable predictor. Maybe because the sample came just from university context and sometimes they do not drive with frequency, so they drive less and will have fewer chances to be involved into an accident and receive fines, since they are less exposed as a driver.

Second Study

In the second study, the participants were 602 drivers coming from the courses to regain points (75.6% men) surveyed from three different places in the Curitiba City (Paraná State). The mean age of respondents was 39.31 years (SD=12.91, range=21 to 85). The total Cronbach's alpha to DAX-BR was 0.83. However the original DAX-BR four factors were dispersed. We had hoped that the factors keep the original DAX-BR structure for this study, but instead there was necessary to discard some items and assumed a different factor structure. One factor named "Adaptive and Construction" stayed as the original one and the other remaining factors were added into the two new factors named "Verbal and Physical" and "Projective."

In the second study, there were no significant differences according to gender on DAX-BR factors. As for active accidents, there were significant group differences on "Verbal and Physical" factor, and the group that was involved in the accidents had the highest mean. As for passive accidents, there were significant group differences to use the Verbal and Physical factor and the group that suffered accidents had the highest mean. For fines, there were significant group differences in these DAX-BR's factors "Verbal and Physical" and "Projective", and the group that received the fines had the highest mean.

There were significant group differences on Errors and on Ordinary Violations by gender, and in both cases men who committed Errors and Ordinary Violations had the highest mean.

The Aggressive Violations had the highest means than the Ordinary Violations, but both values were low.

To active accidents, there were significant group differences in Ordinary and on Aggressive Violations, and in both cases, the group that was involved into an accident had the highest mean. To passive accidents, there were significant group differences in Ordinary and on Aggressive Violations, and in both cases, the group that have done the accident had the highest mean.

About fines, there was a significant group differences in Ordinary Violations, and the group that have received a fine had the highest mean.

As predicted, to gender and active accidents there were significant group differences on DSSS, because men with high means of DSSS tend to be more involved in accidents (Zuckerman & Kuhlman, 2000). Larger positive correlations were expected among DAX-BR factors and other scales but these were not found. We only found medium positive correlations between DAX-BR's factor "Adaptive/Constructive Expression" and Ordinary Violations (DBQ). For all three DBQ's factors, DAX-BR was a good predictor.

It was expected that the participants of the second study had a higher medium punctuation in the DBQ factors than the participants of the first study, because they are an older sample but the opposite was observed.

Third study

In the third study, the idea was to test training to encourage drivers to adopt eco-driving style in order to reduce the aggressiveness in the car driving. It was an individual eight hours training focused to reduce the aggressiveness impact of the drivers and to introduce new behaviours. There were two groups with five drivers each. One was the experimental group and the other was the control group. The experimental group reached the point but as it happened in other studies, it was very important to use the electronic devices as a support to control the drivers. However, drivers have to accept to use these devices, that is why very often these kinds of electronic devices are not enough to change habits. Strategies can be needed lo lead changes. Furthermore, low means to DBQ were found. There was a very high means of DSSS and that should be a further investigation in the future. The results that were got made a significant difference, in the experimental group, between baseline data and the after training data collection.

3. Theoretical Implications

Personality traits cannot be directly observed. So, it is necessary some instruments such tests, scales and questionnaires to measure these personality traits. This often hinders the design intervention strategies that are geared towards providing solutions to aggressive behaviors. The first attempt to formally characterize the phenomena of aggressive driving behavior was done by Tasca (2000) by giving a description of driving being aggressive if “it is deliberate, likely to increase the risk of a collision and is motivated by impatience, annoyance, hostility and/or attempt to save time.” Since Tasca (2002), several studies have tried to explain that. Galovski and Blanchard (2002) used a relatively narrow definition as a behavior that is much intended to hurt others while some authors gave a broader definition as an act that disregards or violates safety with or without intent of endangering others (AAA Foundation for Traffic Safety, 2009, Deffenbacher, Filetti, Lynch, Dahlen & Oetting, 2002; Galovski, Blanchard, Malta & Freidenberg, 2003).

The results of Galovski and Blanchard (2002) have several theoretical implications. In the first part of this thesis, the theoretical framework focused on the conceptualization of the phenomenal of the driving anger and accident. Generally, anger and accidents are measured together (Ferreira et al., 2010; Bolson et al., 2011; González-Iglesias et al., 2012), and they have been here applied together in all three studies.

The conceptualization and theories about the driver’s aggressiveness always try to find ways to understand and reduce the impact of the anger while driving. More precisely, the conceptualization of anger representation and social representation are principally interested in the content of the representation and how the representations are created or in its structure, specifically for social representation (Tasca, 2000; AAA Foundation for Traffic Safety, 2009).

Generally, the theories about behaviors are developed around a model and focused on the relation between the contexts and behavior. As observed by Tasca (2000), the models often include several factors as predictors of a particular behavior. Ajzen (1975) made a distinction between attitudes and other concepts, such as beliefs and behavioral intentions. According to this author, attitude corresponds principally to the positive or negative emotions linked to the attitudinal object (Ajzen, 1975). For us, the evaluative feature of attitudes is a part of the representation, but the main idea that defines our concept of representation is the term of Perugini and Bagozzi (2004) used as a belief, referring to information, knowledge or opinions about the attitudinal object. Intention is different from motivation in the planned behavior theory (TPB, Ajzen, 1985). Aggressive behavior has multiple settings; it can be expressed by a motor via attacks of movement or leakage; by emotional or via ahead hostility to another person trying to express control over other (Fariz et al., 2005; Barros & Silva, 2006). Hostility is something that provokes the driver often to commit violations of rules and causes traffic accidents (Villieux & Delhomme, 2008).

Among emotional factors, anger reflects a predisposition to experience anger more frequently while driving. Therefore, anger refers to the propensity to become angry while driving (Deffenbacher et al., 2003). Driving anger could be considered as an important factor in the prediction of risky behavior on the road, compared to other personality factors such as sensation seeking, impulsivity and hostility (Dahlen et al., 2005; Villieux & Delhomme, 2010). Driving anger can generate risky behavior, in particular for young drivers and that may contribute to explaining their involvement in more road accidents.

Similarly, theoretical frameworks that focused on the cognitive and affective process had a great deal of impact in addressing the situation presented in aggressive driving. The model by Vallières, Bergeron and Vallerand (2005) have its ideas revolving around aggressive driving interaction between two drivers it hypothesized that if one driver perceives the intentional it will provoke him or her anger.

In addition, depending on the psychological characteristics, naturally human being react differently when subjected to different situations and in most cases they are easily agitated if slightly provoked (Weiner, 2001).This is largely contributed by various daily factors. Such factor can be related to family issues, the nature of working environment and the interaction of different people of different ethnic groups or nationality.

The model adopted in this study supports the idea that behavior, personality traits and emotional states are linked. In this sense, the model allows a general point of view concerning the implication of other variables that could be taken into account in future studies.

In this thesis the focus was measuring anger aspects and accidents, principally because the two concepts represent variables that can be brought difference between being dead or alive. In this sense, it seems important to study these two concepts and other drivers' characteristics.

The results of the first study strongly support the study's hypotheses that younger drivers tend to be more aggressive than older drivers. Our conclusion is in the line of several authors (Marín-León et al., 2003; Maxwell et al., 2005; Simons-Morton et al., 2012; Krahé, 2013).

Concerning the theoretical framework used in the second part of this Ph.D. thesis, aggression in general and perceived aggression in particular, are concepts rather new for the study of drivers in Brazil; and, also, aggressive driving is considered as a form of aggression common in everyday life (Krahé, 2013). The study thus innovated when it applied to the perception of aggression in the interaction between car drivers and find out a way to reduce the impact of it through eco-driving. In addition, the study focused on the driver's point of view, using the concept of perceived aggression from Baron and Richardson (1994) to identify the role of the intention of defining aggression from the "victim" perspective.

In the third study, we made a valuable contribution, as the eco-driving study helped reduce the impact of aggressive driver behavior and promote fuel economy. However for this is necessary to work with the driver tactical and behavioral dimensions, for example: as the time to drive, route to take, strategic (to drive with a lighter car) and operational decisions (review the car) of the driver.

4. Societal Implications

For the society, our studies contribute to placing the driver as the focus of the reflection, comparing personality and behavior in a more integrative approach; in which the internal factors and the external factors are complementary. In this sense, the studies carried out aloud the progress of the individual factors.

The study used two concepts to differentiate the processes: on the one hand, the instrument adaptations that give us information about aggressive behavior, while, on the other hand, the practical study that reduces the anger impact on the behaviour. Likewise, the first two studies give different results from two different sample types. That could give us a better data from DAX-BR results. Similarly, the study allowed identify the negative points that need to be corrected or to be improved both for individual (for the drive that use DAX-BR, as a personal evaluation) and societal benefit. The results and the progress can be helpful to the stakeholders and public authorities in implementing communication with data results for campaigns and awareness as well as in the training of drivers which consequently ensure they will have better behavior.

To effectively implement the solution to reduce the social impact of driving anger, it is advisable to understand the causes and the perception of aggressiveness; through this, we are able to understand the source of aggressive driving. Additionally, other strategies may include; strengthening punitive guidelines or develop awareness programs, these are recommendations suggested by NHTSA (2001).

In the last 20 years, surveys are being developed, videos are being created, studies are being conducted, classes for training is being taught, more books are written, more information is available on the internet for bettering the understand in solving the aggressiveness driving problem (James & Nahl, 2000, 2001). The results found could also help in developing actions based on education and pedagogy concerning the adapted behaviors on conflictual road situations. For instance, the car drivers who in the case of a collision have the greater potential to harm others, in response to a behavior previously perceived as aggressive could be changed by to be “tamed” through proper training and education. Overall, education on this issue could help to decode the source of conflicts between drivers. It is important as well to inform and communicate about these difficulties on the road and the factors that contribute such as: the perceived intention of the car driver’s behavior, the perceived danger of the situation, and the social representation.

5. Limits of the Studies

The sample size of the first study and the homogeneity of the sample could be seen as a major limit of this study. However, the aim of this study was to validate the scales.

Concerning the limits of the second study, the questionnaire was the same as the first one but it was necessary to use other structure factorial for the DAX-BR, this is an import issue because was expected to use the same structure in both studies, maybe for different types of sample the use of different instrument structure it was necessary. However, for this type of population it is necessary to carry out more studies using the DAX-BR scale. It is important to be careful about the use of DAX-BR, since the DAX-BR structure did not completely work for this sample type.

Another limitation in this study comes from the fact that it measured only the behavioral components of the aggression. Buss and Perry (1992) noted that trait aggression in a large extend involves affective and cognitive characteristics. However, the study did not measure intention or motivations that lead to driver aggression. Therefore, future research needs to examine the motivating factors underlying the active and passive driver aggression.

Moreover, driver aggression does not occur in isolation but rather it is also determined by aspects that are found within the instigating environment such as the provocation from other drivers and traffic congestion (Hennessy, 1999). Because driving a car is a dynamic activity involving making decisions quickly, as Vallières et al. (2005) said if one driver perceive any type of different intentions of other driver behavior, it can start in the first driver an anger behavior.

Finally, limitations of the third study were the sample size, only with ten drivers, and the fact that the drivers work daily in different routes, so it was more difficult to control variables, in other types of eco-driving studies, as for example by bus drivers, those drivers daily do the same trajectory. A point to consider in the future is that since those drivers worked for a company, the drivers could be having a more controlled behavior while there are driving with the car company. Another point in this study was that there is not a female driver group to make gender comparison. It is important because there is research that point out that age is negatively related to both aggression (Sârbescu, 2012) and vengeance (Romano et al., 2012) and the last one is slightly elevated in female drivers (Simon & Corbett, 1996; Lonczak, 2007). Therefore, younger drivers mostly engage in a retaliatory behavior such as chasing another car, running another motorist off the road and engaging in verbal aggression besides the older drivers.

Another point is that this research dealt with the social desirability. There were questions that included aggressive and dangerous driving behavior which required the respondent to disclose their engagements in illegal driving such as cell phone use while driving, road rage, and speeding, but something the participants could be afraid or with shame to report it in the instrument.

6. Perspectives for future research

After carrying out these three studies, we can point out some perspectives for future research. From the study 1, it was shown evidences of the validity of the DAX-BR scale to be used in future researches. These evidences are the good reliability, the maintenance of the original factors structure in the first study, the positive correlation with other factors of other instruments used as DBQ and the use of DAX-BR as a predictor for violations and errors. As an idea for further studies of evidence of DAX-BR validity, it could be adapted for use by means of an electronic questionnaire, in order to obtain a larger sample. From the second study, it can be used in the final DAX-BR structure, found with three stable factors, to study serious drivers offenders. The use of DAX-BR with drivers offenders can help in the study of anger driver and offender drivers, and this instrument validation could help to become this kind of research more popular. Another study using DAX-BR, it could be with drivers who need to renew the right to drive, something that usually occurs every five years, so we would have results with drivers who drive frequently. In addition, the instrument could be associated with other personality instruments such as *Locus* of Control, or personality scales such as the Big Five, or with DAS, as is often the case that happens in other countries. In the third study, the results can lead to other companies to ask more constantly to this type of training, the eco-driving program, but the research can learn from the difficult that we had in this research to get better results; one way is to use electronic help from car computers or embedded systems.

In most cases aggressive driving research has centered itself in examining the aspects of personality such as impulsiveness and driving anger, it was the case in this study. Some other variables may play a major role in provoking anger therefore; future study should explore into detail the role of these variables in produce anger.

To improve the DAX-BR, it is strongly recommended that a study with offender drivers should be done on why the aspects of the factors “Use of the Car and Physical Agressivity” and “Use of the car to express anger” did not work out properly. As shown in the other studies (Sarbescu, 2012; Villieux & Delhomme, 2010; Sullman, 2015; Stephens & Sullman, 2014), using DAX, it should be more common to use the verbal aggression than to use the car to show the anger, but more research is necessary to sustain this explanation.

It is highly recommended for future research to focus on the eco-driving style to professional drivers, since this type of driver travel larger distances daily, then the benefits that normally the eco-driving style brings will have higher impact for them and for the society.

Overall, there should be researched on aggressive driving behavior and practical actions to reduce the impact of aggression in driving. In the future, research should take into account the combination of self-report measures (DAX-BR) with practical interventions in driving simulators for the training of eco-driving, so that behavioral changes can be faster and more controlled. Since driving simulators are now more accessible in Brazil, due to be mandatory by law that they are present in the driving schools, this research now is possible.

So, a lot of work is needed on this topic before introducing fully autonomous vehicles on roads.

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Annexes

A. First Study Questionary

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Nós, Alessandra Sant´Anna Bianchi e Guilherme Previdi Olandoski pesquisadores da Universidade Federal do Paraná, estamos convidando você condutor de automóvel com idade superior a 19 com carta tipo B ou superior a participar de um estudo intitulado "Comportamento do Condutor e Controle de Velocidade" Procuraremos estudar o comportamento desta população no trânsito.

a) O objetivo desta pesquisa é entender a relação e o comportamento dos jovens condutores frente a velocidade.

b) Caso você participe da pesquisa, será necessário responder os questionários em anexo, cujo tempo médio de resposta é 20 minutos. Você é livre para decidir participar e pode desistir a qualquer momento sem que isto lhe traga prejuízo algum. Os seus dados serão tratados de forma confidencial. Se você concordar em participar por favor, preencha e assine este termo de consentimento e responda os instrumentos em anexo.

c) Alguns riscos relacionados ao estudo podem ser: Eventual Constrangimento em responder sobre os seus comportamentos e atitudes no Trânsito.

d) Os benefícios esperados são: O aumento do conhecimento sobre comportamentos de Velocidade no Trânsito e a Contribuição para uma diferente percepção sobre este fenômeno. No entanto, nem sempre você será diretamente beneficiado com o resultado da pesquisa, mas poderá contribuir para o avanço científico

e) Os pesquisadores (Alessandra Sant'Anna Bianchi professora Doutora do Departamento de Psicologia da UFPR pode ser contactada no telefone (41) 33102649 ou no email Bianchi@ufpr.br ou Guilherme Previdi Olandoski doutorando pode ser contactado no telefone (41) 30914570 ou no email:guilhermepo@yahoo.com), responsáveis por este estudo poderão ser contatados (na Avenida República Argentina, 2403, no horário Comercial ou telefone (41) 30914500) para esclarecer eventuais dúvidas que (o Sr., a Sra. , ou você) possa ter e fornecer-lhe as informações que queira, antes, durante ou depois de encerrado o estudo.

f) A sua participação neste estudo é voluntária e se você não quiser mais fazer parte da pesquisa poderá desistir a qualquer momento e solicitar que lhe devolvam o termo de consentimento livre e esclarecido assinado.

g) As despesas necessárias para a realização da pesquisa não são de sua responsabilidade e pela sua participação no estudo você não receberá qualquer valor em dinheiro.

h) Quando os resultados forem publicados, não aparecerá seu nome, e sim um código.

Eu,___________________________________ li esse termo de consentimento e compreendi a natureza e objetivo do estudo do qual concordei em participar. A explicação que recebi menciona os riscos e benefícios. Eu entendi que sou livre para interromper minha participação a qualquer momento sem justificar minha decisão.

Eu concordo voluntariamente em participar deste estudo.

____

(Assinatura do Participante de pesquisa ou responsável legal)

Curitiba, 2016

Diretivas: Todo mundo se sente irritado ou furioso ao longo do tempo durante a condução, mas as pessoas diferem na maneira que elas reagem quando estão com raiva ao dirigir. Uma série de situações estão listadas abaixo. Leia cada afirmação e em seguida, preencha o quadrado à direita da questão indicando com que frequência você geralmente reage ou se comporta da maneira descrita quando você está irritado ou furioso enquanto está dirigindo. Não há respostas certas ou erradas. Não gaste muito tempo em uma questão.

	Quase Nunca	**As veze s**	**Freqüent emente**	**Quase sempre**
1-Mostro o dedo médio para outro motorista	1	2	3	4
2-Eu dirijo bem próximo ao para-choque do outro motorista.	1	2	3	4
3-Eu dirijo um pouco mais rápido do que estava dirigindo.	1	2	3	4
4-Eu tento cortar a frente do outro motorista.	1	2	3	4
5-Eu xingo outros motoristas em voz alta.	1	2	3	4
6-Eu faço comentários negativos em voz alta sobre outro motorista.	1	2	3	4
7-Eu sigo atrás do outro motorista por um bom tempo.	1	2	3	4
8-Eu tento sair do carro para dar um sermão com outro motorista	1	2	3	4
9-Eu grito frases como "Onde você comprou a sua carteira?"	1	2	3	4
10-Eu abaixo o vidro do carro para ajudar a comunicar minha raiva	1	2	3	4
11-Eu encaro o outro motorista.	1	2	3	4
12-Eu faço uma "banana" para o outro motorista.	1	2	3	4
13-Eu mostro a língua para o outro motorista.	1	2	3	4
14-Eu xingo outro motorista em voz baixa	1	2	3	4
15-Eu acelero para irritar o outro motorista.	1	2	3	4
16-Eu bloqueio propositalmente o outro motorista (para ele não poder fazer o que queria)	1	2	3	4
17-Eu bato no para-choque do outro motorista com o meu para-choque.	1	2	3	4
18-Eu fico louco atrás do volante.	1	2	3	4
19-Eu acendo o farol alto do carro para espelhar no retrovisor do outro motorista.	1	2	3	4
20-Eu tento forçar o outro motorista para o acostamento	1	2	3	4
21-Eu tento assustar o outro motorista.	1	2	3	4
22-Eu faço ao outro motorista o que ele fez comigo.	1	2	3	4
23-Eu presto ainda mais atenção para ser um motorista seguro.	1	2	3	4

24-Eu penso em outras coisas para me distrair de pensar em outro motorista.	1	2	3	4
25-Eu pondero/penso antes de responder.	1	2	3	4
26-Eu tento pensar em soluções positivas para lidar com a situação	1	2	3	4
27-Eu dirijo muito mais rápido do que estava dirigindo.	1	2	3	4
28-Eu falo palavrões para outros motoristas.	1	2	3	4
29-Eu digo para mim mesmo que não vale a pena ficar bravo.	1	2	3	4
30-Eu decido não me rebaixar ao nível	1	2	3	4
31-Eu falo palavrões em voz baixa	1	2	3	4
32-Eu ligo o rádio ou coloco uma música para me acalmar	1	2	3	4
33-Eu jogo luz alta no outro motorista.	1	2	3	4
34-Eu faço gestos hostis a outro motorista, que não seja mostrar o dedo médio.	1	2	3	4
35-Eu tento pensar em coisas positivas para fazer.	1	2	3	4
36-Eu digo a mim mesmo que não vale a pena se envolver	1	2	3	4
37-Eu balanço minha cabeça para o outro motorista.	1	2	3	4
38-Eu grito com outros motoristas	1	2	3	4
39-Eu sussurro comentários negativos sobre o outro motorista	1	2	3	4
40-Eu olho para outro motorista de maneira a expressar minha reprovação	1	2	3	4
41-Eu tento sair do carro para bater no outro	1	2	3	4
42-EU tento aceitar que existem maus motoristas nas ruas.	1	2	3	4
43-Eu penso coisas como "Onde você conseguiu sua licença?	1	2	3	4
44-Eu faço coisas para me acalmar, como ,por exemplo, respirar fundo.	1	2	3	4
45-Eu tento aceitar que existem situações frustrantes enquanto dirijo.	1	2	3	4
46-Eu desacelero para irritar o outro motorista.	1	2	3	4
47-Eu penso em outras coisas para me distrair das frustrações nas estradas	1	2	3	4
48-Eu digo a mim mesmo para ignorar isso	1	2	3	4
49-Eu presto ainda mais atenção no comportamento dos outros motoristas para evitar acidentes.	1	2	3	4

Diretivas: Leia cada afirmação e em seguida, preencha o quadrado à direita da questão indicando com que frequência você geralmente reage ou se comporta da maneira descrita. Não há respostas certas ou erradas. Não gaste muito tempo em uma questão.

Com que frequência você geralmente reage ou se comporta da maneira descrita?	**Quase**	**As vezes**	**Freqüen**	**Quase**
Eu gosto de dirigir o carro de um modo selvagem/agressivo	0	1	2	3
Me sinto constantemente como um piloto de corrida	0	1	2	3
Eu gosto de dirigir em situações que eu não consigo prever o que aconteceria comigo	0	1	2	3
Eu gosto de sentir medo e tensão enquanto dirijo	0	1	2	3
Eu gosto de dirigir em estradas com várias curvas fechadas	0	1	2	3
Eu gostaria (ou iria gostar) de dirigir sem uma rota planejada e sem uma programação	0	1	2	3
Eu gostaria de aprender a dirigir carros que passem dos 300 km/h	0	1	2	3
Eu gosto de ter experiências excitantes enquanto dirijo, mesmo que sejam um pouco assustadoras	0	1	2	3
Eu gosto de motoristas ousados, mesmo que desrespeitem as leis de vez em quando	0	1	2	3
Eu não tenho paciência com pessoas que dirigem de um modo previsível e monótono	0	1	2	3
Eu acredito que iria gostar de experimentar dirigir bem rápido em uma estrada íngreme.	0	1	2	3

Para cada item você é *solicitado a indicar QUÃO FREQÜENTEMENTE, se é o caso, este tipo de coisa tem acontecido com você. Baseie seus julgamentos no que você lembra de você dirigindo nos últimos 12 meses.* Por favor indique seus julgamentos marcando UMA das opções ao lado de cada item. Você vai perceber que estas colunas são encabeçadas por números entre 0 e 5, que significam o seguinte:

Com que freqüência lhe acontece o seguinte?	nunca	quase nunca	poucas vezes	algumas vezes	freqüentemente	quase sempre
1. Bater em alguma coisa, ao dar ré, que você não tinha visto antes.	0	1	2	3	4	5
2. Pretendendo ir para o destino "A", você se dá conta que se encontra no caminho para o destino "B", talvez porque o último é o seu destino mais usual.	0	1	2	3	4	5
3. Dirigir quando você suspeita que você pode estar acima do limite legal de álcool no sangue.	0	1	2	3	4	5
4. Estar na pista errada ao chegar a uma rotatória ou uma junção.	0	1	2	3	4	5
5. Ao estar em uma fila para entrar à direita em uma rua principal, você presta tanta atenção ao fluxo de trânsito na rua principal que você quase bate no carro da frente de você..	0	1	2	3	4	5
6. Não perceber que pedestres estão atravessando, quando entrando em uma rua lateral, vindo de uma rua principal	0	1	2	3	4	5
7. Buzinar para indicar sua contrariedade a outro usuário da via.	0	1	2	3	4	5
8. Não verificar seu espelho retrovisor antes de arrancar, mudar de pista, etc.	0	1	2	3	4	5
9. Freiar muito rapidamente em uma estrada escorregadia, ou tomar a direção errada em uma derrapagem.	0	1	2	3	4	5
10. Parar em uma esquina tão para a frente que o motorista com direito de passagem tem que parar e deixar você passar.	0	1	2	3	4	5
11. Desrespeitar o limite de velocidade em uma rua residencial.	0	1	2	3	4	5
12. Ligar uma coisa, como, por exemplo, os faróis dianteiros quando você pretendia ligar alguma outra coisa, como, por exemplo, os limpadores de pára-brisas..	0	1	2	3	4	5

13. Ao virar à direita, quase bater em um ciclista que vinha pelo seu lado de dentro.	0	1	2	3	4	5
14. "Perder" os sinais de "preferencial" e evitar, por pouco, colidir com o trânsito que tem preferência de passagem..	0	1	2	3	4	5
15. Tentar arrancar o carro, em um semáforo, em terceira marcha.	0	1	2	3	4	5
16. Tentar ultrapassar alguém que você não viu estar sinalizando para entrar à esquerda.....................................	0	1	2	3	4	5
17. Ficar furioso por causa de outro motorista e persegui-lo com a intenção de dizer exatamente o que você pensa dele/dela...	0	1	2	3	4	5
18. Ficar em uma pista da estrada, que você sabe que estará interrompida adiante, até o último instante antes de forçar sua entrada em outra pista.	0	1	2	3	4	5
19. Esquecer onde você deixou seu carro em um estacionamento.	0	1	2	3	4	5
20. Ultrapassar um motorista lento pelo lado direito.	0	1	2	3	4	5
21. Arrancar nos semáforos com a intenção de ser mais rápido que o motorista ao seu lado.	0	1	2	3	4	5
22. Interpretar mal os sinais e sair de uma rotatória na direção errada.	0	1	2	3	4	5
23. Dirigir tão próximo ao carro da frente que seria difícil parar em uma emergência.	0	1	2	3	4	5
24. Cruzar uma junção sabendo que o semáforo já fechou para você..	0	1	2	3	4	5
25. Ficar furioso com um determinado tipo de motorista e indicar sua hostilidade por qualquer meio que você possa.	0	1	2	3	4	5
26. Perceber que você não tem clara lembrança da estrada em que você esteve viajando.................................	0	1	2	3	4	5
27. Subestimar a velocidade de um veículo vindo no sentido contrário, quando está fazendo uma ultrapassagem.	0	1	2	3	4	5

28. Desrespeitar o limite de velocidade em uma auto-estrada.	0	1	2	3	4	5
29. Dirigir muito perto do carro a sua frente com a intenção de que ele vá mais rápido ou saia da sua frente. ...	0	1	2	3	4	5
30. Ficar irritado com um determinado tipo de motorista e mostrar sua hostilidade por qualquer meio possível.	0	1	2	3	4	5

	Discordo totalmente	discordo	Nem discordo ou concordo	concordo	Concordo totalmente
1. As vezes isto acontece de eu estar amargo (a) e cheio (a) de ressentimento	1	2	3	4	5
2. Para mim, até os pequenos incidentes podem ser irritantes	1	2	3	4	5
3.Eu me coloco correntemente em fúria pela maneira que as pessoas me tratam	1	2	3	4	5
4.Não me considero uma pessoa sensível e delicada	1	2	3	4	5
5.Eu sou uma pessoa temperamental	1	2	3	4	5
6.Eu correntemente fico desgostoso com as pessoas que tenho que me relacionar	1	2	3	4	5
7.É necessário que ocorra muitas coisas para que eu fique furioso	1	2	3	4	5
8.Eu tenho a reputação de ter sangue quente e de ficar furioso facilmente	1	2	3	4	5

As questões a seguir referem-se a suas informações pessoais. Elas têm por objetivo traçar um perfil mais preciso da amostra que estamos estudando. Por favor, responda a todas as perguntas.

Sexo: ( ) Masculino ( ) Feminino

Idade: ________

Grau Instrução:

( ) 1º grau incompleto ( ) 2º grau incompleto ( ) 3º grau incompleto

( ) 1º grau completo ( ) 2º grau completo ( ) 3º grau completo

. Há quanto tempo dirige ? ( ) anos

Tipo de carteira de motorista : A ( ) B ( ) A e B ( ) Outras: _____

Quantos dias por semana você dirige?

( ) 0 ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) dirijo raramente

Em que período do dia você costuma conduzir: ( ) dia ( ) noite ( ) dia e noite

Onde, normalmente, você dirige: ( ) estrada ( ) cidade ( ) estrada e cidade

Quantos quilômetros você dirige por ano?

( )Menos de 5 mil Km ( )Entre 5 mil Km e menos de 10 mil Km
( )Entre 10 mil Km e menos de 15 mil Km ( )Entre 15 mil Km e menos de 20 mil Km
( )Entre 20 mil Km e menos de 25 mil Km ( )Entre 25 mil Km e menos de 30 mil Km
( )Mais de 30 mil Km

Quais foram as quantidades e as últimas violações de trânsito pelas quais você foi multado nos **últimos 5 anos (2011 a 2015), pode marcar mais de uma opção**. Caso você nunca tenha feito uma violação escreva **0 (zero)**

Avançar o sinal vermelho: ______ vezes

Exceder o limite de velocidade: _______vezes

Falar ao celular enquanto dirige:_____vezes

Estacionar em desacordo com as normas:______vezes

Parar sobre a faixa do pedestre_______vezes

Dirigir sob efeito do álcool_____vezes

Outra__________________

Em quantos acidentes ativos (você bateu em outro usuário da estrada/rua ou obstáculo) você esteve envolvido (quando você era o motorista) e que resultaram somente em danos materiais durante os últimos 5 anos? ________

Em quantos acidentes ativos (você bateu em outro usuário da estrada/rua ou obstáculo) você esteve envolvido (quando você era o motorista) e que resultaram em pequenos danos a pessoas, como ferimentos leves, durante os últimos 5 anos? ________

Em quantos acidentes ativos (você bateu em outro usuário da estrada/rua ou obstáculo) você esteve envolvido (quando você era o motorista) e que resultaram em grande danos a pessoas, como ferimentos graves ou óbitos, durante os últimos 5 anos? ________

Em quantos acidentes passivos (você foi atingido por outro usuário da estrada/rua ou obstáculo) você esteve envolvido (quando você era o motorista) e que resultaram somente em danos materiais durante os últimos 5 anos? ________

Em quantos acidentes passivos (você foi atingido por outro usuário da estrada/rua ou obstáculo) você esteve envolvido (quando você era o motorista) e que resultaram em pequenos danos a pessoas, como ferimentos leves, durante os últimos 5 anos? ________

Em quantos acidentes passivos (você foi atingido por outro usuário da estrada/rua ou obstáculo) você esteve envolvido (quando você era o motorista) e que resultaram em grande danos a pessoas, como ferimentos graves ou óbitos, durante os últimos 5 anos? ________

	Muito grande	Grande	Média	Pequena	Muito Pequena
Qual a chance de outro motorista ser multado por uma câmera ou radar ao estar Dirigindo?	0	1	2	3	4
Qual a chance de outro motorista ser pego pela polícia por um comportamento errado?	0	1	2	3	4
Qual a chance de outro motorista morrer/ se acidentar no trânsito?	0	1	2	3	4
Qual a chance de você ser multado por uma câmera ou radar ao estar dirigindo?	0	1	2	3	4
Qual a chance de você ser pego pela polícia por um comportamento errado?	0	1	2	3	4
Qual a chance de você morrer / se acidentar no trânsito?	0	1	2	3	4

Por gentileza informe a velocidade em Km/h que você geralmente prefere dirigir:

1 Na estrada de pista dupla____Km/h

2 Numa estrada de pista simples______Km/h

3 Numa estrada de terra_____Km/h

4 No trânsito da cidade______Km/h

.

Com que frequência você dirige acima da velocidade permitida:	**Sempre**	**Frequentemente**	**às vezes**	**Raramente**	**Nunca**
Na cidade	0	1	2	3	4
em estradas de faixa dupla	0	1	2	3	4
em estradas de faixa simples	0	1	2	3	4
em estradas de terra	0	1	2	3	4
Por qual motivo você dirige acima da velocidade permitida da via					
Para economizar tempo ( )	0	1	2	3	4
Para chegar no horário ( )	0	1	2	3	4
Para mostrar suas habilidades de motorista( )	0	1	2	3	4
Pelo prazer ( )	0	1	2	3	4
Outro ( ) Qual?					

Por favor, verifique se respondeu todas as questões. Muito Obrigado.

B. Second Study Questionary

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Nós, Alessandra Sant´Anna Bianchi e Guilherme Previdi Olandoski pesquisadores da Universidade Federal do Paraná, estamos convidando você condutor de automóvel com idade superior a 19 com carta tipo B ou superior a participar de um estudo intitulado "Comportamento do Condutor e Controle de Velocidade" Procuraremos estudar o comportamento desta população no trânsito.

i) O objetivo desta pesquisa é entender a relação e o comportamento dos jovens condutores frente a velocidade.

j) Caso você participe da pesquisa, será necessário responder os questionários em anexo, cujo tempo médio de resposta é 20 minutos. Você é livre para decidir participar e pode desistir a qualquer momento sem que isto lhe traga prejuízo algum. Os seus dados serão tratados de forma confidencial. Se você concordar em participar por favor, preencha e assine este termo de consentimento e responda os instrumentos em anexo.

k) Alguns riscos relacionados ao estudo podem ser: Eventual Constrangimento em responder sobre os seus comportamentos e atitudes no Trânsito.

l) Os benefícios esperados são: O aumento do conhecimento sobre comportamentos de Velocidade no Trânsito e a Contribuição para uma diferente percepção sobre este fenômeno. No entanto, nem sempre você será diretamente beneficiado com o resultado da pesquisa, mas poderá contribuir para o avanço científico

m) Os pesquisadores (Alessandra Sant'Anna Bianchi professora Doutora do Departamento de Psicologia da UFPR pode ser contactada no telefone (41) 33102649 ou no email Bianchi@ufpr.br ou Guilherme Previdi Olandoski doutorando pode ser contactado no telefone (41) 30914570 ou no email:guilhermepo@yahoo.com), responsáveis por este estudo poderão ser contatados (na Avenida República Argentina, 2403, no horário Comercial ou telefone (41) 30914500) para esclarecer eventuais dúvidas que (o Sr., a Sra. , ou você) possa ter e fornecer-lhe as informações que queira, antes, durante ou depois de encerrado o estudo.

n) A sua participação neste estudo é voluntária e se você não quiser mais fazer parte da pesquisa poderá desistir a qualquer momento e solicitar que lhe devolvam o termo de consentimento livre e esclarecido assinado.

o) As despesas necessárias para a realização da pesquisa não são de sua responsabilidade e pela sua participação no estudo você não receberá qualquer valor em dinheiro.

p) Quando os resultados forem publicados, não aparecerá seu nome, e sim um código.

Eu,__________________________________ li esse termo de consentimento e compreendi a natureza e objetivo do estudo do qual concordei em participar. A explicação que recebi menciona os riscos e benefícios. Eu entendi que sou livre para interromper minha participação a qualquer momento sem justificar minha decisão.

Eu concordo voluntariamente em participar deste estudo.

____

(Assinatura do Participante de pesquisa ou responsável legal)

Curitiba, 2014

As questões a seguir referem-se a suas informações pessoais. Elas têm por objetivo traçar um perfil mais preciso da amostra que estamos estudando. Por favor, responda a todas as perguntas.

Sexo: ( ) Masculino ( ) Feminino Idade: ________

Instrução: ( ) 1º grau incompleto ( ) 2º grau incompleto ( ) 3º grau incompleto

( ) 1º grau completo ( ) 2º grau completo ( ) 3º grau completo

. Há quanto tempo dirige ? ( ) anos

Tipo de carteira de motorista : A ( ) B ( ) A e B ( ) Outras: _____

Quantos dias por semana você dirige?

( ) 0 ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) dirijo raramente

Em que período do dia você costuma conduzir: ( ) dia ( ) noite ( ) dia e noite

Onde, normalmente, você dirige: ( ) estrada ( ) cidade ( ) estrada e cidade

Quantos quilômetros você dirige por ano?_______________

Quais foram as últimas violações de trânsito pelas quais você foi multado nos últimos 12 meses? (pode marcar mais de uma opção)
( ) Avançar o sinal vermelho ( ) Exceder o limite de velocidade
( ) Falar ao celular enquanto dirige ( ) Estacionar em desacordo com as normas
( ) Parar sobre a faixa de pedestres ( ) Dirigir sob efeito do álcool
( ) Outras: ____

Quantas vezes você se envolveu em um acidente de trânsito nos últimos 5 anos? Indique o número de vezes no quadro abaixo de acordo com a natureza do(s) acidente(s) e suas conseqüências (caso você nunca tenha se envolvido em um acidente escreva 0):

	Acidentes ativos (você bateu em um obstáculo ou outro usuário da via)	Acidentes passivos (você foi atingido por outro usuário da via)
Danos materiais		
Pequenos danos a pessoas, como ferimentos leves		
Grandes danos a pessoas, como ferimentos graves e óbitos		

As questões a seguir têm por objetivo entender o perfil mais preciso da amostra que estamos estudando. Por favor, responda a todas as perguntas.

	Muito grande	**Grande**	**Média**	**Pequena**	**Muito Pequena**
Qual a chance de outro motorista ser multado por uma câmera ou radar ao estar Dirigindo?	0	1	2	3	4
Qual a chance de outro motorista ser pego pela polícia por um comportamento errado?	0	1	2	3	4
Qual a chance de outro motorista morrer/ se acidentar no trânsito?	0	1	2	3	4
Qual a chance de você ser multado por uma câmera ou radar ao estar dirigindo?	0	1	2	3	4
Qual a chance de você ser pego pela polícia por um comportamento errado?	0	1	2	3	4
Qual a chance de você morrer / se acidentar no trânsito?	0	1	2	3	4

As questões a seguir têm por objetivo entender o perfil mais preciso do comportamento que estamos estudando. Por favor, responda a todas as perguntas.

Com que frequência você dirige acima da velocidade permitida:	**Sempre**	**Frequentemente**	**às vezes**	**Raramente**	**Nunca**
Na cidade	0	1	2	3	4
em estradas de faixa dupla	0	1	2	3	4
em estradas de faixa simples	0	1	2	3	4
em estradas de terra	0	1	2	3	4
Por qual motivo você dirige acima da velocidade permitida da via					
Para economizar tempo ( )	0	1	2	3	4
Para chegar no horário ( )	0	1	2	3	4
Para mostrar suas habilidades de motorista( )	0	1	2	3	4
Pelo prazer ( )	0	1	2	3	4
Outro ( ) Qual?					

Diretivas: Todo mundo se sente irritado ou furioso ao longo do tempo durante a condução, mas as pessoas diferem na maneira que elas reagem quando estão com raiva ao dirigir. Uma série de situações estão listadas abaixo. Leia cada afirmação e em seguida, preencha o quadrado à direita da questão indicando com que frequência você geralmente reage ou se comporta da maneira descrita quando você está irritado ou furioso enquanto está dirigindo. Não há respostas certas ou erradas. Não gaste muito tempo em uma questão.

	Quase Nunca	As veze s	Freqüent emente	Quase sempre
Mostro o dedo médio para outro motorista	0	1	2	3
Eu dirijo bem próximo ao para-choque do outro motorista.	0	1	2	3
Eu dirijo um pouco mais rápido do que estava dirigindo.	0	1	2	3
Eu tento cortar a frente do outro motorista.	0	1	2	3
Eu xingo outros motoristas em voz alta.	0	1	2	3
Eu faço comentários negativos em voz alta sobre outro motorista.	0	1	2	3
Eu sigo atrás do outro motorista por um bom tempo.	0	1	2	3
Eu tento sair do carro para dar um sermão com outro motorista	0	1	2	3
Eu grito frases como "Onde você comprou a sua carteira?"	0	1	2	3
Eu abaixo o vidro do carro para poder comunicar minha raiva	0	1	2	3
Eu encaro o outro motorista.	0	1	2	3
Eu faço uma "banana" para o outro motorista.	0	1	2	3
Eu mostro a língua para o outro motorista.	0	1	2	3
Eu xingo outro motorista em voz baixa	0	1	2	3
Eu acelero para irritar o outro motorista.	0	1	2	3
Eu bloqueio propositalmente o outro motorista (para ele não poder fazer o que queria)	0	1	2	3
Eu bato no para-choque do outro motorista com o meu para-choque.	0	1	2	3
Eu fico louco atrás do volante.	0	1	2	3
Eu acendo o farol alto do carro para espelhar no retrovisor do outro motorista.	0	1	2	3
Eu tento forçar o outro motorista para o acostamento	0	1	2	3
Eu tento assustar o outro motorista.	0	1	2	3
Eu faço ao outro motorista o que ele fez comigo.	0	1	2	3
Eu presto ainda mais atenção para ser um motorista seguro.	0	1	2	3
Eu penso em outras coisas para me distrair de pensar em outro motorista.	0	1	2	3
Eu pondero/penso antes de responder.	0	1	2	3
Eu tento pensar em soluções positivas para lidar com a situação	0	1	2	3
Eu dirijo muito mais rápido do que estava dirigindo.	0	1	2	3
Eu falo palavrões para outros motorista.	0	1	2	3
Eu digo para mim mesmo que não vale a pena ficar bravo.	0	1	2	3
Eu decido não me rebaixar ao nível	0	1	2	3
Eu falo palavrões em voz baixa	0	1	2	3

Eu ligo o rádio ou coloco uma música para me acalmar	0	1	2	3
Eu utilizo o pisca do carro para outro motorista.	0	1	2	3
Eu faço gestos hostis a outro motorista, que não seja mostrar o dedo médio.	0	1	2	3
Eu tento pensar em coisas positivas para fazer.	0	1	2	3
Eu digo a mim mesmo que não vale a pena se envolver	0	1	2	3
Eu balanço minha cabeça para o outro motorista.	0	1	2	3
Eu grito com outros motoristas	0	1	2	3
Eu sussurro comentários negativos sobre o outro motorista	0	1	2	3
Eu olho para outro motorista de maneira a expressar minha reprovação	0	1	2	3
Eu tento sair do carro para bater no outro	0	1	2	3
EU tento aceitar que existem maus motoristas nas ruas.	0	1	2	3
Eu penso coisas como "Onde você conseguiu sua licença?	0	1	2	3
Eu faço coisas para me acalmar, como por exemplo respirar fundo.	0	1	2	3
Eu tento aceitar que existem situações frustrantes enquanto dirijo.	0	1	2	3
Eu desacelero para irritar o outro motorista.	0	1	2	3
EU penso em outras coisas para me distrair das frustrações nas estradas	0	1	2	3
Eu digo a mim mesmo para ignorar isso	0	1	2	3
Eu presto ainda mais atenção no comportamento dos outros motoristas para evitar acidentes.	0	1	2	3

Questionário de Busca por sensações ao dirigir

Diretivas: Leia cada afirmação e em seguida, preencha o quadrado à direita da questão indicando com que frequência você geralmente reage ou se comporta da maneira descrita. Não há respostas certas ou erradas. Não gaste muito tempo em uma questão.

	Quase Nunca	**As vezes**	**Freqüentemente**	**Quase sempre**
Eu gosto de dirigir o carro de um modo selvagem/agressivo	0	1	2	3
Me sinto constantemente como um piloto de corrida	0	1	2	3
Eu gosto de dirigir em situações que eu não consigo prever o que aconteceria comigo	0	1	2	3
Eu gosto de sentir medo e tensão enquanto dirijo	0	1	2	3
Eu gosto de dirigir em estradas com várias curvas	0	1	2	3

fechadas				
Eu gostaria (ou iria gostar) de dirigir sem uma rota planejada e sem uma programação	0	1	2	3
Eu gostaria de aprender a dirigir carros que passem dos 300 km/h	0	1	2	3
Eu gosto de ter experiências excitantes enquanto dirijo, mesmo que sejam um pouco assustadoras	0	1	2	3
Eu gosto de motoristas ousados, mesmo que desrespeitem as leis de vez em quando	0	1	2	3
Eu não tenho paciência com pessoas que dirigem de um modo previsível e monótono	0	1	2	3
Eu acredito que iria gostar de experimentar dirigir bem rápido em uma estrada íngreme.	0	1	2	3

Para cada item você é solicitado a indicar QUÃO FREQÜENTEMENTE, se é o caso, este tipo de coisa tem acontecido com você. Baseie seus julgamentos no que você lembra de você dirigindo nos últimos 12 meses. Por favor indique seus julgamentos marcando UMA das opções ao lado de cada item. Você vai perceber que estas colunas são encabeçadas por números entre 0 e 5, que significam o seguinte:

Com que freqüência lhe acontece o seguinte?	nunca	quase nunca	poucas vezes	algumas vezes	freqüentemente	quase sempre
1. Bater em alguma coisa, ao dar ré, que você não tinha visto antes.	0	1	2	3	4	5
2. Pretendendo ir para o destino "A", você se dá conta que se encontra no caminho para o destino "B", talvez porque o último é o seu destino mais usual.	0	1	2	3	4	5
3. Dirigir quando você suspeita que você pode estar acima do limite legal de álcool no sangue.	0	1	2	3	4	5
4. Estar na pista errada ao chegar a uma rotatória ou uma junção..	0	1	2	3	4	5
5. Ao estar em uma fila para entrar à direita em uma rua principal, você presta tanta atenção ao fluxo de trânsito na rua principal que você quase bate no carro da frente de você..	0	1	2	3	4	5

6. Não perceber que pedestres estão atravessando, quando entrando em uma rua lateral, vindo de uma rua principal.. 0 1 2 3 4 5

7. Buzinar para indicar sua contrariedade a outro usuário da via. 0 1 2 3 4 5

8. Não verificar seu espelho retrovisor antes de arrancar, mudar de pista, etc. 0 1 2 3 4 5

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9. Freiar muito rapidamente em uma estrada escorregadia, ou tomar a direção errada em uma derrapagem. 0 1 2 3 4 5

10. Parar em uma esquina tão para a frente que o motorista com direito de passagem tem que parar e deixar você passar.. 0 1 2 3 4 5

11. Desrespeitar o limite de velocidade em uma rua residencial. 0 1 2 3 4 5

12. Ligar uma coisa, como, por exemplo, os faróis dianteiros quando você pretendia ligar alguma outra coisa, como, por exemplo, os limpadores de pára-brisas.. .. 0 1 2 3 4 5

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13. Ao virar à direita, quase bater em um ciclista que vinha pelo seu lado de dentro. 0 1 2 3 4 5

14. "Perder" os sinais de "preferencial" e evitar, por pouco, colidir com o trânsito que tem preferência de passagem... 0 1 2 3 4 5

15. Tentar arrancar o carro, em um semáforo, em terceira marcha. 0 1 2 3 4 5

16. Tentar ultrapassar alguém que você não viu estar sinalizando para entrar à esquerda. 0 1 2 3 4 5

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17. Ficar furioso por causa de outro motorista e persegui-lo com a intenção de dizer exatamente o que você pensa dele/dela.. 0 1 2 3 4 5

18. Ficar em uma pista da estrada, que você sabe que estará interrompida adiante, até o último instante antes de forçar sua entrada em outra pista. 0 1 2 3 4 5

19. Esquecer onde você deixou seu carro em um 0 1 2 3 4 5

estacionamento. ....

20. Ultrapassar um motorista lento pelo lado direito.	0	1	2	3	4	5
21. Arrancar nos semáforos com a intenção de ser mais rápido que o motorista ao seu lado.	0	1	2	3	4	5
22. Interpretar mal os sinais e sair de uma rotatória na direção errada.	0	1	2	3	4	5
23. Dirigir tão próximo ao carro da frente que seria difícil parar em uma emergência.	0	1	2	3	4	5
24. Cruzar uma junção sabendo que o semáforo já fechou para você.	0	1	2	3	4	5
25. Ficar furioso com um determinado tipo de motorista e indicar sua hostilidade por qualquer meio que você possa.	0	1	2	3	4	5
26. Perceber que você não tem clara lembrança da estrada em que você esteve viajando.	0	1	2	3	4	5
27. Subestimar a velocidade de um veículo vindo no sentido contrário, quando está fazendo uma ultrapassagem.	0	1	2	3	4	5
28. Desrespeitar o limite de velocidade em uma auto-estrada.	0	1	2	3	4	5

Por favor verifique se respondeu todas as questões.   Obrigado!

C. Third Study Questionary

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Nós, Alessandra Sant´Anna Bianchi e Guilherme Previdi Olandoski pesquisadores da Universidade Federal do Paraná, estamos convidando você condutor de automóvel com idade superior a 19 com carta tipo B ou superior a participar de um estudo intitulado "Comportamento do Condutor e Controle de Velocidade" Procuraremos estudar o comportamento desta população no trânsito.

q) O objetivo desta pesquisa é entender a relação e o comportamento dos jovens condutores frente a velocidade.

r) Caso você participe da pesquisa, será necessário responder os questionários em anexo, cujo tempo médio de resposta é 20 minutos. Você é livre para decidir participar e pode desistir a qualquer momento sem que isto lhe traga prejuízo algum. Os seus dados serão tratados de forma confidencial. Se você concordar em participar por favor, preencha e assine este termo de consentimento e responda os instrumentos em anexo.

s) Alguns riscos relacionados ao estudo podem ser: Eventual Constrangimento em responder sobre os seus comportamentos e atitudes no Trânsito.

t) Os benefícios esperados são: O aumento do conhecimento sobre comportamentos de Velocidade no Trânsito e a Contribuição para uma diferente percepção sobre este fenômeno. No entanto, nem sempre você será diretamente beneficiado com o resultado da pesquisa, mas poderá contribuir para o avanço científico

u) Os pesquisadores (Alessandra Sant'Anna Bianchi professora Doutora do Departamento de Psicologia da UFPR pode ser contactada no telefone (41) 33102649 ou no email Bianchi@ufpr.br ou Guilherme Previdi Olandoski doutorando pode ser contactado no telefone (41) 30914570 ou no email:guilhermepo@yahoo.com), responsáveis por este estudo poderão ser contatados (na Avenida República Argentina, 2403, no horário Comercial ou telefone (41) 30914500) para esclarecer eventuais dúvidas que (o Sr., a Sra. , ou você) possa ter e fornecer-lhe as informações que queira, antes, durante ou depois de encerrado o estudo.

v) A sua participação neste estudo é voluntária e se você não quiser mais fazer parte da pesquisa poderá desistir a qualquer momento e solicitar que lhe devolvam o termo de consentimento livre e esclarecido assinado.

w) As despesas necessárias para a realização da pesquisa não são de sua responsabilidade e pela sua participação no estudo você não receberá qualquer valor em dinheiro.

x) Quando os resultados forem publicados, não aparecerá seu nome, e sim um código.

Eu,_________________________________ li esse termo de consentimento e compreendi a natureza e objetivo do estudo do qual concordei em participar. A explicação que recebi menciona os riscos e benefícios. Eu entendi que sou livre para interromper minha participação a qualquer momento sem justificar minha decisão.

Eu concordo voluntariamente em participar deste estudo.

____

(Assinatura do Participante de pesquisa ou responsável legal)

Curitiba, 2014

As questões a seguir referem-se a suas informações pessoais. Elas têm por objetivo traçar um perfil mais preciso da amostra que estamos estudando. Por favor, responda a todas as perguntas.

Sexo: ( ) Masculino ( ) Feminino Idade: ________

Instrução: ( ) 1º grau incompleto ( ) 2º grau incompleto ( ) 3º grau incompleto

( ) 1º grau completo ( ) 2º grau completo ( ) 3º grau completo

. Há quanto tempo dirige ? ( ) anos

Tipo de carteira de motorista : A ( ) B ( ) A e B ( ) Outras: _____

Quantos dias por semana você dirige?

( ) 0 ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) dirijo raramente

Em que período do dia você costuma conduzir: ( ) dia ( ) noite ( ) dia e noite

Onde, normalmente, você dirige: ( ) estrada ( ) cidade ( ) estrada e cidade

Quantos quilômetros você dirige por ano?_______________

Quais foram as últimas violações de trânsito pelas quais você foi multado nos últimos 12 meses? (pode marcar mais de uma opção)
( ) Avançar o sinal vermelho ( ) Exceder o limite de velocidade
( ) Falar ao celular enquanto dirige ( ) Estacionar em desacordo com as normas
( ) Parar sobre a faixa de pedestres ( ) Dirigir sob efeito do álcool
( ) Outras: ____

Quantas vezes você se envolveu em um acidente de trânsito nos últimos 5 anos? Indique o número de vezes no quadro abaixo de acordo com a natureza do(s) acidente(s) e suas conseqüências (caso você nunca tenha se envolvido em um acidente escreva 0):

	Acidentes ativos (você bateu em um obstáculo ou outro usuário da via)	Acidentes passivos (você foi atingido por outro usuário da via)
Danos materiais		
Pequenos danos a pessoas, como ferimentos leves		
Grandes danos a pessoas, como ferimentos graves e óbitos		

As questões a seguir têm por objetivo entender o perfil mais preciso da amostra que estamos estudando. Por favor, responda a todas as perguntas.

	Muito grande	**Grande**	**Média**	**Pequena**	**Muito Pequena**
Qual a chance de outro motorista ser multado por uma câmera ou radar ao estar Dirigindo?	0	1	2	3	4
Qual a chance de outro motorista ser pego pela polícia por um comportamento errado?	0	1	2	3	4
Qual a chance de outro motorista morrer/ se acidentar no trânsito?	0	1	2	3	4
Qual a chance de você ser multado por uma câmera ou radar ao estar dirigindo?	0	1	2	3	4
Qual a chance de você ser pego pela polícia por um comportamento errado?	0	1	2	3	4
Qual a chance de você morrer / se acidentar no trânsito?	0	1	2	3	4

As questões a seguir têm por objetivo entender o perfil mais preciso do comportamento que estamos estudando. Por favor, responda a todas as perguntas.

Com que frequência você dirige acima da velocidade permitida:	**Sempre**	**Frequentemente**	**às vezes**	**Raramente**	**Nunca**
Na cidade	0	1	2	3	4
em estradas de faixa dupla	0	1	2	3	4
em estradas de faixa simples	0	1	2	3	4
em estradas de terra	0	1	2	3	4
Por qual motivo você dirige acima da velocidade permitida da via					
Para economizar tempo ( )	0	1	2	3	4
Para chegar no horário ( )	0	1	2	3	4
Para mostrar suas habilidades de motorista( )	0	1	2	3	4
Pelo prazer ( )	0	1	2	3	4
Outro ( ) Qual?					

Diretivas: Todo mundo se sente irritado ou furioso ao longo do tempo durante a condução, mas as pessoas diferem na maneira que elas reagem quando estão com raiva ao dirigir. Uma série de situações estão listadas abaixo. Leia cada afirmação e em seguida, preencha o quadrado à direita da questão indicando com que frequência você geralmente reage ou se comporta da maneira descrita quando você está irritado ou furioso enquanto está dirigindo. Não há respostas certas ou erradas. Não gaste muito tempo em uma questão.

	Quase Nunca	As veze s	Freqüent emente	Quase sempre
Mostro o dedo médio para outro motorista	0	1	2	3
Eu dirijo bem próximo ao para-choque do outro motorista.	0	1	2	3
Eu dirijo um pouco mais rápido do que estava dirigindo.	0	1	2	3
Eu tento cortar a frente do outro motorista.	0	1	2	3
Eu xingo outros motoristas em voz alta.	0	1	2	3
Eu faço comentários negativos em voz alta sobre outro motorista.	0	1	2	3
Eu sigo atrás do outro motorista por um bom tempo.	0	1	2	3
Eu tento sair do carro para dar um sermão com outro motorista	0	1	2	3
Eu grito frases como "Onde você comprou a sua carteira?"	0	1	2	3
Eu abaixo o vidro do carro para poder comunicar minha raiva	0	1	2	3
Eu encaro o outro motorista.	0	1	2	3
Eu faço uma "banana" para o outro motorista.	0	1	2	3
Eu mostro a língua para o outro motorista.	0	1	2	3
Eu xingo outro motorista em voz baixa	0	1	2	3
Eu acelero para irritar o outro motorista.	0	1	2	3
Eu bloqueio propositalmente o outro motorista (para ele não poder fazer o que queria)	0	1	2	3
Eu bato no para-choque do outro motorista com o meu para-choque.	0	1	2	3
Eu fico louco atrás do volante.	0	1	2	3
Eu acendo o farol alto do carro para espelhar no retrovisor do outro motorista.	0	1	2	3
Eu tento forçar o outro motorista para o acostamento	0	1	2	3
Eu tento assustar o outro motorista.	0	1	2	3
Eu faço ao outro motorista o que ele fez comigo.	0	1	2	3
Eu presto ainda mais atenção para ser um motorista seguro.	0	1	2	3
Eu penso em outras coisas para me distrair de pensar em outro motorista.	0	1	2	3
Eu pondero/penso antes de responder.	0	1	2	3
Eu tento pensar em soluções positivas para lidar com a situação	0	1	2	3
Eu dirijo muito mais rápido do que estava dirigindo.	0	1	2	3
Eu falo palavrões para outros motorista.	0	1	2	3
Eu digo para mim mesmo que não vale a pena ficar bravo.	0	1	2	3
Eu decido não me rebaixar ao nível	0	1	2	3
Eu falo palavrões em voz baixa	0	1	2	3

Eu ligo o rádio ou coloco uma música para me acalmar	0	1	2	3
Eu utilizo o pisca do carro para outro motorista.	0	1	2	3
Eu faço gestos hostis a outro motorista, que não seja mostrar o dedo médio.	0	1	2	3
Eu tento pensar em coisas positivas para fazer.	0	1	2	3
Eu digo a mim mesmo que não vale a pena se envolver	0	1	2	3
Eu balanço minha cabeça para o outro motorista.	0	1	2	3
Eu grito com outros motoristas	0	1	2	3
Eu sussurro comentários negativos sobre o outro motorista	0	1	2	3
Eu olho para outro motorista de maneira a expressar minha reprovação	0	1	2	3
Eu tento sair do carro para bater no outro	0	1	2	3
EU tento aceitar que existem maus motoristas nas ruas.	0	1	2	3
Eu penso coisas como "Onde você conseguiu sua licença?	0	1	2	3
Eu faço coisas para me acalmar, como por exemplo respirar fundo.	0	1	2	3
Eu tento aceitar que existem situações frustrantes enquanto dirijo.	0	1	2	3
Eu desacelero para irritar o outro motorista.	0	1	2	3
EU penso em outras coisas para me distrair das frustrações nas estradas	0	1	2	3
Eu digo a mim mesmo para ignorar isso	0	1	2	3
Eu presto ainda mais atenção no comportamento dos outros motoristas para evitar acidentes.	0	1	2	3

Questionário de Busca por sensações ao dirigir

Diretivas: Leia cada afirmação e em seguida, preencha o quadrado à direita da questão indicando com que frequência você geralmente reage ou se comporta da maneira descrita. Não há respostas certas ou erradas. Não gaste muito tempo em uma questão.

	Quase Nunca	**As vezes**	**Freqüentemente**	**Quase sempre**
Eu gosto de dirigir o carro de um modo selvagem/agressivo	0	1	2	3
Me sinto constantemente como um piloto de corrida	0	1	2	3
Eu gosto de dirigir em situações que eu não consigo prever o que aconteceria comigo	0	1	2	3
Eu gosto de sentir medo e tensão enquanto dirijo	0	1	2	3
Eu gosto de dirigir em estradas com várias curvas	0	1	2	3

fechadas				
Eu gostaria (ou iria gostar) de dirigir sem uma rota planejada e sem uma programação	0	1	2	3
Eu gostaria de aprender a dirigir carros que passem dos 300 km/h	0	1	2	3
Eu gosto de ter experiências excitantes enquanto dirijo, mesmo que sejam um pouco assustadoras	0	1	2	3
Eu gosto de motoristas ousados, mesmo que desrespeitem as leis de vez em quando	0	1	2	3
Eu não tenho paciência com pessoas que dirigem de um modo previsível e monótono	0	1	2	3
Eu acredito que iria gostar de experimentar dirigir bem rápido em uma estrada íngreme.	0	1	2	3

Para cada item você é solicitado a indicar QUÃO FREQÜENTEMENTE, se é o caso, este tipo de coisa tem acontecido com você. Baseie seus julgamentos no que você lembra de você dirigindo nos últimos 12 meses. Por favor indique seus julgamentos marcando UMA das opções ao lado de cada item. Você vai perceber que estas colunas são encabeçadas por números entre 0 e 5, que significam o seguinte:

Com que freqüência lhe acontece o seguinte?	nunca	quase nunca	poucas vezes	algumas vezes	freqüentemente	quase sempre
1. Bater em alguma coisa, ao dar ré, que você não tinha visto antes.	0	1	2	3	4	5
2. Pretendendo ir para o destino "A", você se dá conta que se encontra no caminho para o destino "B", talvez porque o último é o seu destino mais usual.	0	1	2	3	4	5
3. Dirigir quando você suspeita que você pode estar acima do limite legal de álcool no sangue.	0	1	2	3	4	5
4. Estar na pista errada ao chegar a uma rotatória ou uma junção...	0	1	2	3	4	5
5. Ao estar em uma fila para entrar à direita em uma rua principal, você presta tanta atenção ao fluxo de trânsito na rua principal que você quase bate no carro da frente de você..	0	1	2	3	4	5

6. Não perceber que pedestres estão atravessando, quando entrando em uma rua lateral, vindo de uma rua principal..	0	1	2	3	4	5
7. Buzinar para indicar sua contrariedade a outro usuário da via.	0	1	2	3	4	5
8. Não verificar seu espelho retrovisor antes de arrancar, mudar de pista, etc.	0	1	2	3	4	5
9. Freiar muito rapidamente em uma estrada escorregadia, ou tomar a direção errada em uma derrapagem.	0	1	2	3	4	5
10. Parar em uma esquina tão para a frente que o motorista com direito de passagem tem que parar e deixar você passar..	0	1	2	3	4	5
11. Desrespeitar o limite de velocidade em uma rua residencial..	0	1	2	3	4	5
12. Ligar uma coisa, como, por exemplo, os faróis dianteiros quando você pretendia ligar alguma outra coisa, como, por exemplo, os limpadores de pára-brisas.. ..	0	1	2	3	4	5
13. Ao virar à direita, quase bater em um ciclista que vinha pelo seu lado de dentro.	0	1	2	3	4	5
14. "Perder" os sinais de "preferencial" e evitar, por pouco, colidir com o trânsito que tem preferência de passagem...	0	1	2	3	4	5
15. Tentar arrancar o carro, em um semáforo, em terceira marcha.	0	1	2	3	4	5
16. Tentar ultrapassar alguém que você não viu estar sinalizando para entrar à esquerda......................................	0	1	2	3	4	5
17. Ficar furioso por causa de outro motorista e persegui-lo com a intenção de dizer exatamente o que você pensa dele/dela..	0	1	2	3	4	5
18. Ficar em uma pista da estrada, que você sabe que estará interrompida adiante, até o último instante antes de forçar sua entrada em outra pista.	0	1	2	3	4	5
19. Esquecer onde você deixou seu carro em um	0	1	2	3	4	5

estacionamento.						
20. Ultrapassar um motorista lento pelo lado direito.	0	1	2	3	4	5
21. Arrancar nos semáforos com a intenção de ser mais rápido que o motorista ao seu lado.	0	1	2	3	4	5
22. Interpretar mal os sinais e sair de uma rotatória na direção errada.	0	1	2	3	4	5
23. Dirigir tão próximo ao carro da frente que seria difícil parar em uma emergência.	0	1	2	3	4	5
24. Cruzar uma junção sabendo que o semáforo já fechou para você.	0	1	2	3	4	5
25. Ficar furioso com um determinado tipo de motorista e indicar sua hostilidade por qualquer meio que você possa.	0	1	2	3	4	5
26. Perceber que você não tem clara lembrança da estrada em que você esteve viajando.	0	1	2	3	4	5
27. Subestimar a velocidade de um veículo vindo no sentido contrário, quando está fazendo uma ultrapassagem.	0	1	2	3	4	5
28. Desrespeitar o limite de velocidade em uma auto-estrada.	0	1	2	3	4	5

Por favor verifique se respondeu todas as questões.   Obrigado!

Nome: Placa do Carro:

KM inicial do carro: KM final do Carro:

Data de revisão do carro:

No dia:

O trânsito estava: ( ) calmo; ( ) fluído; ( ) normal; ( ) lento; ( ) carregado;

A condição do tempo era: ( ) ensolarado; ( ) alta temperatura ; ( ) temperatura média; ( ) frio; ( ) com chuva;

O trajeto foi realizado: ( ) de forma mental; ( ) com auxílio do GPS;

Quanto ao carro o mesmo: ( ) estava muito carregado; ( ) carregado; ( ) normal; ( ) leve; ( ) muito leve;

No trajeto alguma vez você acelerou de maneira abrupta: ( ) não; ( ) sim; Quantas vezes: __ ;

No trajeto alguma vez você freou de maneira abrupta: ( ) não; ( ) sim; Quantas vezes: _____ ;

Para qual bairro você atendeu a chamada:_____

Qual a quantidade de litros abastecidos no final do dia:_____