

Personality and Driving Behavior

The Role of Extraversion and Neuroticism in Drivers' Behavior Toward Bicyclists

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Abstract

Bicycling is associated with a variety of personal and societal benefits and it is an important political agenda to increase the number of bicyclists on the roads. However, bicyclists are vulnerable to aggressive traffic behavior and harassment from drivers, and bicyclists' safety concerns stand out as a barrier against increased bicycling. Even so, research on mechanisms underlying drivers' behavior toward bicyclists is scarce. The present study aimed at exploring the relationship between personality and driving behavior. In a sample of 1196 Norwegian drivers, the present study examined the direct, indirect and moderating effects of drivers' extraversion and neuroticism on their aggressive and considerate behavior toward bicyclists. Results from bivariate correlation analyses showed that extraversion was positively associated with both aggressive and considerate behavior, while neuroticism was positively correlated with aggressive behavior and negatively associated with considerate behavior. Multiple hierarchical regression analyses revealed that the effect of neuroticism on both aggressive and considerate behavior was partially mediated by whether drivers were positive or negative toward sharing the road with bicyclists (attitudes). Regression analysis also showed that extraversion moderated the effect of attitudes on considerate behavior. It is proposed that these findings may be explained in light of the five-factor personality framework, the frustration-aggression model and personal maladjustment theory. Possible implications of the findings are discussed.

Keywords: bicycling, driving behavior, personality, extraversion, neuroticism, attitudes

Introduction

In a modern, industrialized society, using the roads may be one of the most dangerous activities for the majority of the population (James & Nahl, 2000). Bicyclists represent one of the most vulnerable groups of road users. They have a great likelihood of being involved in accidents, and they are likely to be injured when even minor accidents occur (Wood, Lacherez, Marszalek & King, 2009). In an Australian study (Watson & Cameron, 2006), it was estimated that bicyclists' average probability of being seriously injured, if involved in a crash, was 27 %. In another Australian study (Wood et al., 2009), 48 % of bicyclists reported having been involved in accidents or near accidents with cars. Based on the accident database for Great Britain, Basford, Reid, Lester, Thomson and Tolmie (2002) found that 10 % of all reported accidents with personal injuries, in the period of 1996-1998, involved a bicyclist. Bjørnskau (2005) warns that it is difficult to estimate the true number of accidents with personal injuries involving bicyclists, because (a) a great number of bicycle accidents involve only the bicyclists themselves, and bicyclists may not find any good reasons for reporting such accidents, and (b) a great number of bicyclists are not aware that accidents with personal injuries should be reported to the police. According to Bjørnskau (2005), one can roughly estimate that the total number of accidents with personal injuries involving bicyclists in Norway reached approximately 4500 in 2004.

In addition to being particularly prone to accident involvement and injuries, empirical evidence suggests that bicyclists are vulnerable to aggressive traffic behavior and harassment from drivers. Heesch, Sahlqvist and Garrard (2011) studied 1830 bicyclists in Queensland, Australia. In their study, 76 % of male bicyclists and 72 % of female bicyclists reported having been victims of harassment (e.g., shouting and yelling, obscene gestures) from drivers in the previous 12 months. In Norway, Fyhri, Bjørnskau and Sørensen (2012) discovered that a significant proportion of bicyclists had been subjected to various forms of aggressive behavior from drivers during a one-year period. Of 3788 bicyclists, 61 % reported having experienced aggressive and threatening driving by drivers, 20 % had been squeezed off the road by a car, 25 % had been yelled at by drivers, and 13 % reported having been splashed down with cars' washer fluid (Fyhri et al., 2012, p. 22).

Compared to driving, bicycling carries a variety of personal and societal benefits, including improved personal health, reduced energy consumption, and reduced air and noise pollution (Pucher & Dijkstra, 2003). Increasing the amount of bicyclists is thus an important political agenda. For example, Norwegian authorities have stated that the total increase in urban personal transport should be handled by increased bicycling and public transport (Norwegian

Ministry of Transport and Communications, 2012-2013). However, research suggests that bicyclists' safety concerns and fear of drivers' aggressive behavior stand out as major barriers against increased bicycling (e.g., Davies, Halliday, Mayes & Pocock, 1997; Davies & Hartley, 1998; Rissel, Campbell, Ashley & Jackson, 2002). Norwegian authorities have estimated that bicycling constitutes only 4 % of the total transportation in the country (Norwegian Ministry of Transport and Communications, 2012-2013). Low bicycling rates may, at least partially, be a reflection of the actual prevalence of drivers' aggressive behavior, which in turn may produce further safety concerns (Garrard, Crawford & Hakman, 2006; Heesch et al., 2011; Rissel et al., 2002). Thus, producing knowledge about drivers' behavior toward bicyclists seems imperative.

Driving Behavior

Driving behavior comprises a wide range of behavioral categories. Ben-Ari, Mikulincer and Gillath (2004), distinguished between four major driving styles: (a) reckless and careless driving, (b) anxious driving, (c) angry and hostile driving, and (d) patient and careful driving. Regarding bicyclists' safety concerns and drivers' behavior toward bicyclists, aggressive (i.e., angry and hostile) behavior and considerate driving behavior (i.e., patient and careful) seems to be of particular importance.

Defining aggressive driving behavior. Aggression is a key construct in psychology, although the discipline has not been able to reach a unifying theory or consensus regarding how to define aggression. Ethologists, for example, conceptualize aggression as an instinctive behavioral pattern emerging as a reaction to specific environmental stimuli, Freudian writers tend to treat aggression as a conscious manifestation of the death instinct Thanatos, while social learning theorists view aggression as learned responses, e.g., as a result of learning through observing models having their aggressive behavior reinforced (Reber & Reber, 2001, p. 17). Opatow (2000, p. 404) defines aggression as any form of behavior directed toward the goal of harming or injuring another living being who is motivated to avoid such treatment. According to Berkowitz (1993) there are two classes of aggression: (a) instrumental aggression, defined as harmful acts intended to achieve other goals than harm itself (e.g., attain social status and establish dominance), and (b) hostile aggression, i.e., behavior with the ultimate goal of inflicting harm, injury or death on another person.

Balogun, Shenge and Oladipo (2012, p. 84) propose that aggressive driving can be understood as "a form of automobile operation in which an operator will deliberately behave

with contempt toward other drivers and drive in such a manner as to increase the risk of an automobile accident". Shinar (1998, p. 139) believes aggressive driving to be "a syndrome of frustration-driven instrumental behaviors which are manifested in: (a) inconsiderateness towards or annoyance of other drivers (...), and (b) deliberate dangerous driving to save time at the expense of others". The definitions offered by both Balogun et al. (2012) and Shinar (1998) seems to focus on drivers' aggressive behavior toward other drivers, and not toward other road users such as bicyclists, and Balogun et al.'s definition focuses on increased risk for traffic accidents rather than aggressive behavior manifested through harassment.

Ulleberg (2004) distinguishes between three main classes of aggressive driving: (a) road rage, (b) driving with an intention of intimidating other road users, and (c) driving that is perceived intimidating by other road users. *Road rage* encompasses driving behavior with an intention of inflicting physical og psychological harm on another road user (see also Lajunen, Parker & Stradling, 1998), e.g., intentionally run down bicyclists or pedestrians. *Driving with an intention of intimidating other road users* includes purposefully placing other road users in physical and/or psychological danger, e.g., as a result of anger, frustration or to achieve a certain goal (see also Shinar, 1998). This class of aggressive driving behavior can be either hostile or instrumental (Shinar, 1998). Ulleberg (2004) notes that these classes of aggressive driving behavior may be problematic insofar that they presuppose intention – it is difficult to obtain an objective measure of intentions, given that it is only the driver him- or herself that is aware of what motivated the driving behavior. Hence, Ulleberg (2004) includes *driving that is perceived intimidating by other road users*, regardless of the driver's intent, as a third class of aggressive driving behavior. According to Fyhri et al. (2012), aggressive driving behavior toward bicyclists may include yelling, honking the car horn, displaying negative gestures, and squeezing the car in in front of a bicyclist so that he or she has to stop.

Defining considerate driving behavior. The research literature is rather scarce when it comes to studying considerate driving behavior. Adopting a patient and careful driving style (Ben-Ari et al., 2004), or regularly performing positive or considerate traffic behavior, involves having "'good manners of driving' which are learnt by experience in traffic" (Özkan & Lajunen, 2005, p. 365). Özkan and Lajunen (2005, p. 361) developed a scale for measuring positive driving behavior (the Positive Driver Behaviours Scale), which included items such as "Do my best not to be obstacle for other drivers", "Pay attention to puddle not to splash water on pedestrians or other road users", and "Let pedestrians cross even if it is my right to pass". Özkan and Lajunen (2005) found that considerate driving behavior was negatively

related to aggressive driving, but nevertheless warned that differences between different categories of driving behavior may not be completely distinct. First, driving behavior that would typically be related to aggression may, in fact, reflect consideration. For instance, committing traffic violations may be linked to aggressive driving, yet crossing a road's barrier line (a violation) in order to pass a bicyclist with a satisfactory distance, may still be understood as an act of consideration. Second, it is possible for a driver to act both non-aggressively and non-considerately simultaneously, i.e., the absence of consideration does not necessarily imply the presence of aggression. For instance, a driver who passes a bicyclist a bit too fast and somewhat too close, does not necessarily have any intention of harming or frightening the bicyclist, but nevertheless does so by acting non-considerately. According to Fyhri et al. (2012), considerate behavior toward bicyclists may include making sure that there is at least 1.5 metres distance to bicyclists when passing, and trying to achieve eye contact with bicyclists at intersections.

The Frustration-Aggression Model

The frustration-aggression model often appears as a theoretical framework in the driving behavior literature. Originally stated by Dollard, Doob, Mowrer, Miller and Sears (1939), the model conceptualizes aggression as a "sequence of behavior, the goal-response to which is the injury of the person toward whom it is directed" (p. 9). The key points in the model are that aggression is a result of frustration and that frustration occurs when an individual experiences having his or her personal goal(s) thwarted: "[T]he occurrence of aggressive behaviour always presupposes the existence of frustration, and contrariwise, the existence of frustration always leads to some form of aggression" (Dollard et al., 1939, p. 1). The model is based on the psychodynamic notion that human beings have a fixed level of psychological energy and that psychological task performance is cathartic, i.e., that it brings the psychological system back to an equilibrium (Hogg & Vaughan, 2005). According to Dollard et al. (1939), establishing personal goals arouses psychological energy that will remain activated until the goal is achieved. If the goal is not achieved (i.e., is frustrated), then the psychological system will remain in a state of disequilibrium that can be balanced by behaving aggressively. It is easy to see why this model is an appealing framework in traffic psychology. For instance, a driver who wants to reach a destination as quickly as possible (personal goal) may behave aggressively toward another road user (e.g., a bicyclist) who slows him or her down (an obstacle that produces frustration).

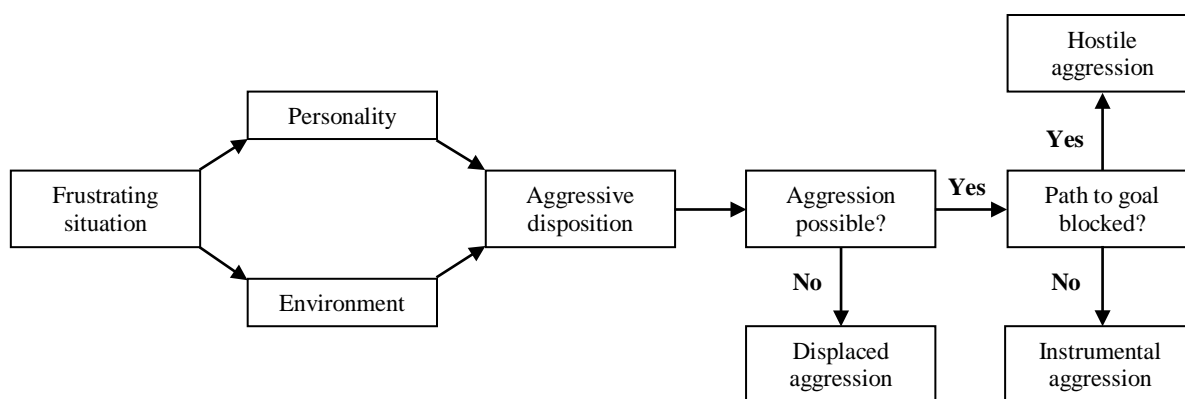


Figure 1. Schematic representation of Shinar's frustration-aggression model. Adapted from "Aggressive driving: The contribution of the drivers and the situation," by D. Shinar, 1998, *Transportation Research Part F: Traffic Psychology and Behaviour*, 1(2), p. 140.

Shinar (1998) applied the frustration-aggression framework to the traffic context. As illustrated in Figure 1, once exposed to a frustrating traffic situation (e.g., being blocked by a bicyclist), features of the driver's personality interact with environmental factors (e.g., anonymity, poor communication, congestion) to determine whether an aggressive disposition is produced. Whether aggression is perceived as possible, depends on factors such as cultural norms and enforcement. Like Berkowitz (1993), Shinar (1998) assumes that aggressive behavior can be either instrumental or hostile. In the context of driving, instrumental aggression includes aggressive behavior aimed at overcoming the frustrating obstacle (e.g., horn honking, running red lights), while hostile aggression comprises behavior aimed at hurting the frustrator rather than solving the actual problem.

Shinar (1998) maintains that the frustration-aggression model is a serviceable framework in traffic psychology, especially since it can be conceptualized as a systems approach. "As such it can be used to show that aggressive driving can be reduced not only by changing driver behavior directly (e.g., through enforcement) but also through changes in the environment that breeds aggression" (Shinar, 1998, p. 139). Shinar (1998) conducted a series of studies to investigate whether frustrating environmental factors (congestion, reduced mobility) were associated with driver aggression (horn honking, running red lights), and found that to be the case. An appealing advantage of the frustration-aggression model is that it is capable of explaining both mild and more serious forms of driving aggression (Lennon & Watson, 2011). However, the findings are mixed and psychological research on general aggression has questioned the view that frustration necessarily leads to aggression (e.g., Baron

& Richardson, 1994). Nevertheless, Shinar's (1998) model is particularly interesting in that it ascribes personality factors a central role in producing aggressive driving.

Situational factors. Findings within the field of driving aggression have largely focused on social and environmental factors. In a major literature review, Ulleberg (2004) identified several factors that may contribute to lower drivers' threshold for aggression, among them anonymity, congested roads, poor communication and type of car. The threshold for behaving aggressively against other people may be lower when both the victim and the perpetrator stand out as anonymous (e.g., sitting inside a car) (Turner, Layton & Simons, 1975; Elison, Govern, Petri & Figler, 1995; Ulleberg, 2004). Congested roads may produce aggressive behavior through stress and frustration as a result of drivers having their need for mobility thwarted (Bjørnskau, 1994; Shinar, 1998), especially when obstacles in traffic are perceived as unnecessary and unexpected (Bjørnskau, 1994). Bicyclists using the roads may, from drivers' perspective, be perceived as unnecessary and somewhat unexpected obstacles and, might, as such, be a source of frustration. Also, it has been argued that poor communication in the traffic situation makes it difficult for drivers to assume other road users' perspective, and thus increases the risk of drivers appraising other road users' behavior as hostile, which, in turn, may lead to aggression (Mesken, Hagenzieker & Rothengatter, 2003).

Individual factors. Every driver is, from time to time, exposed to aggression-provoking situations on the road, yet not every driver behaves aggressively to the same extent toward other road users. Driving behavior, like human behavior in general, is influenced by both environmental factors and individual tendencies (Jovanovic, Lipovac, Stanojevic & Stanojevic, 2011). According to Elander, West and French (1993), a major challenge for the field of psychology is to explore the human factors and psychological mechanisms that underlie driving behavior. However, some authors warn against placing too much emphasis on individual differences. Shinar (1998) shows that the prevalence of aggressive driving behavior has increased over time, while there is no plausible reason to believe that drivers have gone through personality changes and become more aggressive individuals. Rather, Shinar (1998, p. 141) suggests that the increase in aggressive behavior to a large extent can be explained by road conditions that elicit aggressive behavior have been altered over time. Nevertheless, drivers' personal characteristics have received increased attention in the research literature during the last decades (Oltedal & Rundmo, 2006).

Defining personality. Prior to the 1920s, the term "personality" was primarily used in ethical and religious writings before being implemented into the field of abnormal psychology, a field dominated by psychiatry rather than psychology (Barenbaum & Winter, 2008). The first psychological review of personality emerged in 1921 (Allport, 1921). In the 1920s and 1930s, personality was a central focus in both psychiatry and psychology, as well as in sociology with its focus on social adjustment and social roles (Barenbaum & Winter, 2008). Whereas psychiatrists and sociologists primarily were interested in "the study of individual persons as unique, integrated wholes", the psychological approach to personality was dominated by a focus on "individual differences, or the dimensions along which people differ from each other" (Barenbaum & Winter, 2008, p. 7). Within psychology, personality have been studied from different perspectives. Endler and Parker (1992) argue that four perspectives – psychodynamic, situational, interactional and trait – have been central. The psychodynamic approach conceptualizes human behavior largely as the result of unconscious desires, while the situational perspective emphasizes the importance of environmental factors (Walters, 2000). The trait position focuses on identifying and organizing the traits or dimensions on which people differ, whereas an interactional stance can be seen as an attempt to combine the situational and trait perspectives by emphasizing the interaction between the environment and the individual (Walters, 2000). Aggressive driving behavior have been studied from different theoretical perspectives.

A variety of definitions of personality have been offered. Walters (2000, p. 178) defines personality as "an internalized attribute of reasonable consistency and stability to which individual differences in behavior can be ascribed". Personality traits can, according to McCrae and Costa (1990), be conceptualized as individual personality dimensions consisting of distinct and consistent patterns of cognitions, emotions and behavior. Internal dispositions, cross-situational consistency and cross-temporal consistency are key concepts in nearly every definition of personality (Walters, 2000). That is, personality resides within the individual, it is relatively stable across situations, as well as relatively stable across time.

The Five-Factor Personality Framework

After decades of research, most researchers within the field of personality psychology have reached an initial consensus on the "Big Five" as a taxonomy for personality traits (John, Naumann & Soto, 2008). The five-factor model was constructed based on the natural language, i.e., on words describing personality traits and personality differences. Through this lexical approach, the superordinate five factors were derived and identified through factor

analyses (John et al., 2008). The first factor, extraversion, is characterized by an "*energetic approach* toward the social and material world and includes traits such as sociability, activity, assertiveness, and positive emotionality", and high scores on extraversion have behavioral correlates such as taking lead roles in groups and approaching strangers at parties (John et al., 2008, p. 139). Extraverts have a high level of energy, particularly oriented toward other people, while introverts (the low pole of extraversion) tend to focus more on tasks than on people. In the NEO Personality Inventory-Revised (NEO-PI-R; Costa & McCrae, 1992), warmth, gregariousness, assertiveness, activity, excitement seeking and positive emotions figure as facets (lower-level traits) under extraversion. The second factor, agreeableness, focuses on the individual's social relationships (prosocial versus antisocial), and includes traits like trust, straightforwardness, altruism, compliance, modesty and tender-mindedness (Costa & McCrae, 1992). Conscientiousness, the third factor, revolves around socially prescribed impulse control that facilitates task- and goal-directed behavior; highly conscientious individuals tend to be very good at organizing, prioritizing and planning (John et al., 2008, p. 138). Conscientiousness consists of the facets competence, order, dutifulness, achievement striving, self-discipline and deliberation (Costa & McCrae, 1992). The fourth factor, neuroticism, "contrasts emotional stability and even-temperedness with *negative emotionality*, such as feeling anxious, nervous, sad, and tense" (John et al., 2008, p. 138), and includes anxiety, angry hostility, depression, self-consciousness, impulsiveness and vulnerability as lower-level traits (Costa & McCrae, 1992). It is important to note that high scores on neuroticism is not equivalent to being "neurotic" in a clinical sense. High scores on neuroticism do, however, predict poor coping, frequent job changes and experience of burnout (John et al., 2008, p. 138). Openness, the fifth and last factor, regards "the breadth, depth, originality, and complexity of an individual's *mental and experiential life*" (John et al., 2008, p. 138). Openness consists of the facets fantasy, aesthetics, feelings, actions, ideas and values (Costa & McCrae, 1992).

Importantly, the five-factor model is atheoretical in nature – it describes structural relationships between the traits, but it does not postulate the traits' causes, how they develop or which consequences they may entail (John et al., 2008). McCrae and Costa's (1996) five-factor theory, on the other hand, is a personality theory, based on the five-factor model, that places its emphasis on three core components: (a) basic tendencies (i.e., the personality dimensions identified in the five-factor model), (b) characteristic adaptations, and (c) self-

concept¹. Additionally, the theory includes a peripheral (interfacing) focus on biological bases, external influences and objective biography (McCrae & Costa, 2008). Basic tendencies are believed to be largely genetically based, universal and display both cross-situational and cross-temporal stability (McCrae & Costa, 1996). Basic tendencies are believed to affect the characteristic adaptations and the self-concept. Characteristic adaptations comprise more manifest aspects of personality, such as habits, social roles, cognitive schemas and attitudes (McCrae & Costa, 2008). The adaptations reflect the individual's psychological core, and are thus termed characteristic. Furthermore, they contribute to the individual's adaptation to the environment (and are thus termed adaptations). Unlike biologically based basic tendencies, characteristic adaptations are thought to be quite sensitive to external influences, and according to McCrae and Costa (2008), they may even be conceptualized as culturally conditioned.

Evidence supporting the five-factor theory primarily comes from research on the five-factor model. According to Larsen and Buss (2008, p. 83), "[t]he five factors have been found by more than a dozen researchers using different samples", and the factor structure "has been replicated in every decade for the past half-century". The model is also supported by cross-cultural evidence. For instance, the universality of the factors was demonstrated in a observer rating study that found factor replications in 50 different cultures (McCrae, Terracciano & Members of the Personality Profiles of Cultures Project, 2005). McCrae and Costa (2008, p. 169) conclude that "[t]he traits of the FFM [five-factor model] exist and are similarly related in all cultures so far studied". The five-factor personality framework is, however, not without its critics. The model has been criticized for having dimensions (factors) that are too broad and abstract, and thus unable to capture the natural variation in human personality (e.g., Block, 1995; McAdams, 1992). On the other hand, the five-factor framework has been able to predict a variety of life outcomes, including health (Hampson & Friedman, 2008) and psychopathology (Widiger & Smith, 2008), as well as work and academic outcomes (e.g., Mount, Barrick & Stewart, 1998; Nofle & Robins, 2007).

Personality and Driving Behavior: Empirical Findings

Personality psychology has become a serviceable framework for studying driving behavior (Galovski & Blanchard, 2004), and several authors have found associations between personality variables and driving behavior (e.g., Benfield, Szlemko & Bell, 2007; Berdoulat,

¹ Self-concept is conceptualized as part of the characteristic adaptations, but is often emphasized as a distinct core component (see McCrae & Costa, 1996, 2008).

Vavassori & Sastre, 2013; Bone & Mowen, 2006; Clarke & Robertson, 2005; Dahlen, Martin, Ragan & Kuhlman, 2005; Deffenbacher, Lynch & Richards, 2003; Jonah, 1997; Jovanovic et al., 2011; Lajunen, 2001; Miles & Johnson, 2003; Oltedal & Rundmo, 2006; Ulleberg, 2004; Ulleberg & Rundmo, 2003). According to John et al. (2008), extraversion and neuroticism represent the two most universally accepted dimensions in the five-factor personality framework. Hence, these dimensions constitute the focus of the present study. As such, it is beyond the scope of the present study to investigate the role of the other personality dimensions in the five-factor framework (conscientiousness, agreeableness and openness) in drivers' behavior toward bicyclists. It is, furthermore, beyond the scope of the present study to explore the effects of specific personality profiles, i.e., the potential effects of possible combinations of personality traits.

Several previous studies have found associations between extraversion and neuroticism, and driving-related behavior, although results are mixed. Lajunen (2001) investigated road traffic fatalities in 34 nations and found a positive relationship between extraversion and number of traffic fatalities (nations with high traffic fatalities had higher scores on extraversion than those with lower fatalities). In this study, neuroticism showed no significant relationship with road fatalities. One must, however, exercise some caution when interpreting such results. Aggregated findings on a group level cannot necessarily be deduced to an individual level. That is, finding an association between extraversion and traffic fatalities on a group level (nation level) does not necessarily imply that the same association is present on an individual level. Likewise, not finding a significant relationship between neuroticism and traffic fatalities on a group level does not rule out the possibility of the presence of such a relationship on an individual level. While studying the relationships between gender, personality traits, risky driving behavior and accident involvement in a Norwegian sample of 1356 young drivers, Oltedal and Rundmo (2006) found a positive correlation between aggression (facet under neuroticism) and both risky driving and accidents with damages. Anxiety (facet under neuroticism) correlated negatively with accident involvement, and excitement seeking (facet under extraversion) correlated positively with both risky driving and accidents with damages. However, these traits explained only a small proportion of the variance (Oltedal & Rundmo, 2006, p. 626). Jovanovic et al. (2011) conducted a study among 260 Serbian drivers in order to investigate the effect of the five-factor personality traits on aggressive driving behavior. They found that neuroticism predicted aggressive behavior and that this effect was mediated by driver's anger. There was a small and non-significant correlation between extraversion and aggressive behavior. In a sample of 204 psychology

students, Benfield et al. (2007) found that high scores on extraversion were associated with more self-reported aggressive driving, and in a meta-analysis of 47 studies of the relationship between the Big Five traits and accident involvement, Clarke and Robertson (2005) identified extraversion as a valid and generalizable predictor of traffic accidents. This meta-analysis did not, however, use aggressive driving behavior as a criterion for inclusion, but rather accidents and/or injuries. The trait sensation seeking, which is similar to the extraversion facet excitement seeking, has been extensively connected to driving behavior. In a review of the literature on sensation seeking in traffic contexts, Jonah (1997) concluded that the majority of studies demonstrated a positive association between sensation seeking and risky driving.

According to social maladjustment theory, aggressive driving is merely a facet of an individual's general pattern of antisocial behavior (Mayer & Treat, 1977; Tillman & Hobbs, 1949), or as Canadian psychiatrists Tillman and Hobbs stated: "Man drives as he lives". The theory posits that an aggressive driver is an individual that is generally aggressive in everyday life (Lennon, Watson, Arlidge & Fraine, 2011), a stance that enjoys some empirical support. Measures of aggressive driving have been found to correlate strongly with measures of general aggression (e.g., Rotton, Gregory & Van Rooy, 2005; Van Rooy, Rotton & Burns, 2006), and findings suggest that drivers in treatment for aggressive behavior are characterized by a high prevalence of antisocial disorders (e.g., Galovski, Blanchard & Veazey, 2002). Several studies support the position that a high score on general aggression is associated with being aggressive in traffic (e.g., Deery & Fildes, 1999; Deffenbacher, Huff, Lynch, Oetting & Salvatore, 2000; Deffenbacher et al., 2003; Lajunen & Parker, 2001; Ulleberg, 2002a). In further support of social maladjustment theory, research has found a relationship between social deviance and aggressive driving behavior (e.g., Underwood, Chapman, Wright & Crundall, 1999; Ulleberg, 2002a). Using cluster analysis, Ulleberg (2002a) studied more than 2500 Norwegian drivers between the age of 18 and 23. He identified two high-risk groups, the first group characterized by aggression and anger, both in traffic and in everyday life, the second group characterized by social deviance (irresponsibility, normlessness). Similarly, Olstedal and Rundmo (2006) found, while studying 1356 Norwegian adolescent drivers, a strong correlation between normlessness and risky driving behavior. McGuire (1956) reported that unsafe drivers scored significantly higher than safe drivers on several scales of the Minnesota Multiphasic Personality Inventory (MMPI; Hathaway & McKinley, 1951), including the psychopathic deviate scale (scale 4). Empirical findings support that social maladjustment theory may be a serviceable framework for explaining aggressive driving, especially serious and violent traffic behavior (Lennon et al., 2011). Social maladjustment

theory may, however, not explain milder forms of aggressive driving behavior that typically occurs among otherwise law abiding drivers (Lennon et al., 2011).

Related to social maladjustment theory, personal maladjustment theory suggests that aggressive drivers are characterized by being subjected to acute or chronic stress and challenging life periods (Mayer & Treat, 1977; Selzer, Rogers & Kern, 1968). This theory finds empirical support in studies that have found an association between stress and driving aggression (e.g., Hennessy & Wiesenthal, 1997; Hennessy, Wiesenthal & Kohn, 2000; Kontogiannis, 2006). As such, one can argue that personal maladjustment theory is convergent with the five-factor framework in the sense that individuals with high scores on neuroticism are inclined to experience elevated stress levels (Costa & McCrae, 1992). Individuals experiencing high stress levels may rely on ineffective coping strategies and as a result react with aggression in typically non-provocative situations (Stephens & Groeger, 2009). However, the evidence supporting personal maladjustment theory is mixed, and the results may in some studies be biased as result of studying drivers who have already been involved in car accidents (see Galovski, Malta & Blanchard, 2006).

Even though driving behavior (i.e., drivers' behavior toward other drivers) has been a major focus in the research literature, research on drivers' behavior toward bicyclists is scarce (Heesch et al., 2011).

Mediation Models and the Role of Attitudes

Even though several studies point to associations between personality variables and driving behavior, the strength of these associations tend to be quite small. Beirness (1993) suggests that this may be a result of personality being indirectly related to driving behavior. According to the five-factor theory of personality, personality traits (basic tendencies) affect characteristic adaptations (which includes attitudes and cognitive schemas), which in turn influence how the individual adapts to the environment and behaves in specific situations (McCrae & Costa, 1996, 2008). Ulleberg (2002b, p. 27) emphasizes that attitudes may be of particular interest because they are believed to reflect underlying motivations that subsequently may affect behavior. Hogg and Vaughan (2005, p. 150) define attitudes as relatively enduring organizations of beliefs, feelings and behavioral tendencies toward socially significant objects, groups, events or symbols. Unlike personality traits, attitudes are evaluative and refer to specific phenomena, thus making personality traits more stable and fundamental than attitudes (Ulleberg, 2002b). The notion that personality traits are largely genetically based (e.g., McCrae & Costa, 1996, 2008) further supports that traits are more

fundamental than attitudes. As such, one may presuppose a causal relationship in that traits are seen as variables influencing attitudes, which in turn influence behavior (Ulleberg & Rundmo, 2003, p. 436). Attitudes may thus be conceptualized as reflections of enduring personality traits (Elander et al., 1993), or even as integral parts of personality (Smith, Bruner & White, 1956), in accordance with how the five-factor theory of personality sees attitudes as parts of characteristic adaptations (McCrae & Costa, 1996, 2008).

Ulleberg and Rundmo (2003) conducted a study among 1932 young Norwegian drivers in order to investigate individual differences in risky driving behavior and traffic accident involvement. They found that the association between personality traits (including aggression and anxiety, facets under neuroticism) and risky driving behavior was mediated by attitudes. Hence, Ullerberg and Rundmo (2003, p. 427) concluded that "personality primarily influences risky driving behaviour indirectly through affecting the attitudinal determinants of the behaviour".

The Present Study

The present study aims to explore the relationship between personality and driving behavior. More precisely, it seeks to investigate the role of extraversion and neuroticism in drivers' aggressive and considerate behavior toward bicyclists.

Research on drivers' behavior toward bicyclists is scarce (Heesch et al., 2011), yet increasing the number of bicyclists on the roads has been emphasized as an important political agenda (Norwegian Ministry of Transport and Communications, 2012-2013) given the considerable variety of personal and societal benefits of bicycling compared to driving (Pucher & Dijkstra, 2003). It is thus important to produce knowledge that may shed light on the mechanisms that underlie drivers' behavior toward bicyclists. Research is also scarce on the prevalence of aggressive driving in a Norwegian context (Ulleberg, 2004). Research on the association between personality and behavior is needed because behavioral manifestations of personality traits remain largely ignored within the personality assessment literature compared to the progress made in other areas of personality psychology (Wu & Clark, 2003, p. 231). Moreover, knowledge concerning mechanisms that underlie drivers' considerate or positive behavior, as opposed to aggressive behavior, is generally lacking (Özkan & Lajunen, 2005).

In a few ways, the present study differs from the majority of personality-related research on driving behavior. First, most research has employed personality measures on a facet-level, whereas the present study employs measures of extraversion and neuroticism as broad

personality dimensions, i.e., on a high level of abstraction. Second, research on driving behavior has traditionally used aggressive behavior as outcome variable. The present study operates with both aggressive and considerate behavior as outcome variables. In the domain of traffic safety, an exclusive focus on damage control and negative experiences (e.g., aggressive driving) may not be serviceable. A safe traffic environment may be characterized not only by the lack of destructive and dangerous behavior, but also by the presence of road users' proactive efforts. Hence, the present study is not only interested in the mechanisms that may underlie drivers' aggressive behavior toward bicyclists, but also in factors that may influence drivers' proactive or considerate behavior toward bicyclists.

Hypotheses. Most drivers experience frustrating traffic situations involving bicyclists from time to time, yet drivers react differently to these situations. Shinar's (1998) frustration-aggression model predicts that personality plays a central role in determining whether a driver reacts aggressively in a frustrating traffic situation. The five-factor model (Costa & McCrae, 1992) proposes that high scores on extraversion are associated with lower-level traits such as assertiveness, and empirical studies have found an association between extraversion and driving behavior (e.g., Benfield et al., 2007; Clarke & Robertson, 2005; Jonah, 1997; Lajunen, 2001). Moreover, the five-factor model proposes that high scores on neuroticism are associated with negative emotionality, anxiety, angry hostility and stress vulnerability (Costa & McCrae, 1992), while personal maladjustment theory predicts that people who experience high stress levels tend to behave aggressively in traffic (Mayer & Treat, 1977; Selzer et al., 1968). Some evidence supports a link between neuroticism and driving behavior (Jovanovic et al., 2011; Oltedal & Rundmo, 2006; Ulleberg & Rundmo, 2003).

Hence, it is hypothesized that extraversion and neuroticism have positive effects on aggressive behavior, and that these effects are partially mediated by attitudes. It is also assumed that extraversion and neuroticism have negative effects on considerate behavior, and that these effects, as well, are partially mediated by attitudes.

Additionally, the present study seeks to investigate whether scores on the personality dimensions (extraversion and neuroticism) not only influences behavior through attitudes, but also whether personality variables influence the effects of attitudes on aggressive and considerate behavior. One may assume that an individual's score on a personality trait can influence to what extent his or her attitudes affect behavior. Extreme personality scores may have the potential of somewhat overriding or muting the role of attitudes on behavior. It is, for instance, conceivable that introverts (individuals low on extraversion) are governed by their

internal attitudes to a different extent than extraverts (individuals high on extraversion). Likewise, it is assumable that attitudes play a greater role in determining emotionally stable individuals' (those low on neuroticism) behavior than emotionally unstable individuals (those high on neuroticism) who may be more affected by negative emotions, anxiety and stress.

Thus, it is hypothesized that the effect of attitudes on behavior (aggressive and considerate) is moderated by extraversion and neuroticism.

A hypothetical model of the study variables is depicted in Figure 2.

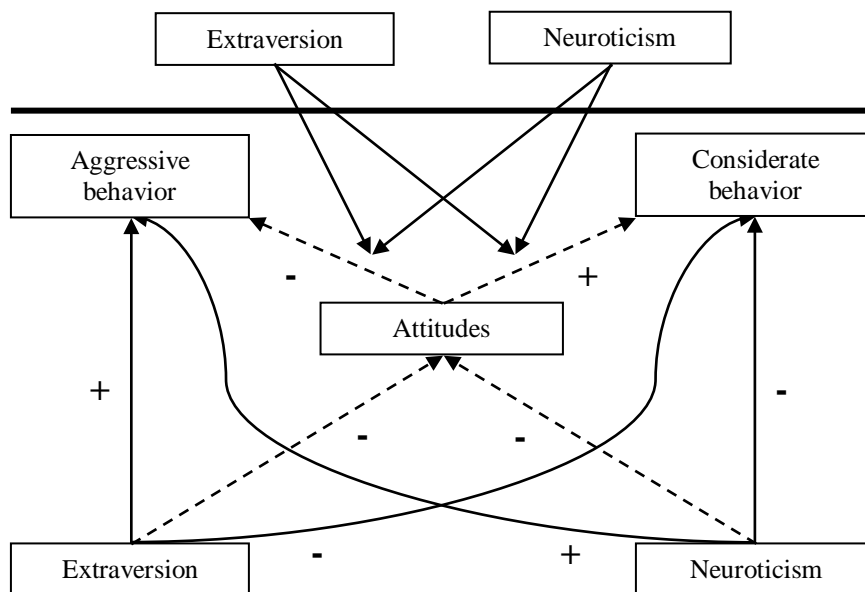


Figure 2. Hypothetical model of the study variables. Above the divider, extraversion and neuroticism are hypothesized as moderator variables. Below the divider, extraversion and neuroticism are hypothesized as predictor variables, while the attitude variable is hypothesized as a mediator. Solid lines indicate direct relationships. Dotted lines indicate indirect relationships.

Method

Participants

In the present study, 1196 Norwegian drivers responded on a web-based questionnaire designed to measure their personality traits, attitudes toward bicyclists and behavior toward bicyclists. The sample consisted of 28 % females and 72 % males, drivers above the age of 55 constituted approximately half of the sample, and 67 % of the participants had completed higher education above high school (see Table 1).

Table 1

General Characteristics of the Sample

Characteristic	%
Gender	
Female	28
Male	72
Age	
< 25	2
25-34	11
35-44	16
45-54	21
55-64	26
> 65	23
Educational level	
Elementary school	9
High school	24
Higher education (1-4 years)	34
Higher education (> 4 years)	33

Note. N=1196

The present sample represents a quite skewed gender distribution. Furthermore, since drivers above the age of 55 constitute almost half of the sample, the sample probably consists of older, and likely more experienced, drivers than the average Norwegian driver. This should be kept in mind when drawing conclusions from the present study.

Sampling Procedure

Participants were recruited through the membership directory of the Norwegian Automobile Association. E-mails with invitations to participate in the study were sent to 5027 drivers (see Appendix A). The e-mails were equipped with a hyperlink to the web-based questionnaire. Some of the e-mail addresses (36) were not valid, and 3795 failed to respond or refused to participate in the study. A total of 1196 (24 %) of those who received the invitation completed the questionnaire. Participants were informed that they could win a reward of 5.000 NOK. Furthermore, they were informed about the study's aim and confidentiality, and assured that it was voluntary to participate. The study has been approved by the Norwegian Social Science Data Services.

Questionnaire Measures

The web-based questionnaire consisted of instruments and items designed to measure drivers' personality traits (extraversion and neuroticism), attitudes toward bicyclists and behavior toward bicyclists (aggressive and considerate) (see Appendix B). Additionally, five demographic variables were included in the survey (gender, age, educational level, political orientation and geographical location).

Extraversion and neuroticism. In line with the Big Five personality taxonomy, drivers' personality dimensions of extraversion and neuroticism were measured using the Norwegian version of the Big Five Inventory (BFI) (Engvik & Føllesdal, 2005). BFI was developed in the early 1990s (see John & Srivastata, 1999) to address the need for a short instrument for personality assessment and consists of 44 items designed to measure the five factors in the Big Five taxonomy (John et al., 2008). BFI uses short statements based on trait adjectives, and thus differs somewhat from other commonly used Big Five assessment instruments, such as Goldberg's (1992) 100-item trait descriptive adjectives (TDA), which uses only single adjectives, and the NEO Personality Inventory (Costa & McCrae, 1992), which uses a more complex sentence format. BFI are thus capable of retaining the brevity and simplicity that characterizes the trait adjective approach without the pitfall of ambiguous meanings, and is moreover easier to understand than the more complex format found in the NEO approach (John et al., 2008). Another advantage of the BFI is its efficiency, given that an administration takes approximately five minutes (Benet-Martinez & John, 1998).

The BFI has good psychometric properties despite the fact that its scales includes only eight or ten items. Reliability (internal consistency measured through Cronbach's alpha, α)

estimates for the BFI, in American samples, typically ranges from .75 to .90, with an average above .80 (Rammstedt & John, 2005, 2007). Similarly, three month test-retest reliability estimates range from .80 to .90, with an average of .85 (Rammstedt & John, 2005, 2007). Furthermore, validity evidence indicates substantial convergent and divergent relations with other Big Five assessment instruments (Rammstedt & John, 2005, 2007).

In the Norwegian version of BFI (Engvik & Føllesdal, 2005), the original five point Likert scale has been replaced with a seven point Likert scale. The Norwegian version has been tested on a Norwegian sample, resulting in satisfactory alpha reliability values (extraversion=.82, agreeableness=.75, conscientiousness=.81, neuroticism=.84, openness=.80) (Engvik & Føllesdal, 2005).

In the present study, participants were measured on the BFI dimensions of extraversion and neuroticism. On a scale ranging from one (strongly disagree) to seven (strongly agree), participants were asked to indicate the extent to which the BFI statements applied to them. The extraversion items included statements such as "Is talkative", "Is full of energy" and "Is outgoing, sociable". Among the neuroticism items were statements such as "Can be tense", "Gets nervous easily" and "Worries a lot". Reversed items were recoded and sum scores were calculated for each of the personality dimensions. Thus, a high score on extraversion reflected high extraversion (low introversion) and a high score on neuroticism indicated high neuroticism (low emotional stability). Internal consistency, measured through Cronbach's α , was estimated for both extraversion (α =.78) and neuroticism (α =.79). These estimates were somewhat lower than those found by Engvik and Føllesdal (2005), but are still well above .70 which, according to DeVellis (2003), serves as a convention of satisfactory internal consistency in the social sciences.

Attitudes toward bicyclists using the road. Drivers' attitudes toward bicyclists using the road were measured using a five-item scale in Norwegian developed by the Institute of Transport Economics (Fyhri et al., 2012). On a Likert scale from one (strongly agree) to seven (strongly disagree) participants were asked to state to what extent they agreed with statements such as "Most bicyclists are considerate toward drivers" and "Bicyclists have just as much right to use the road as drivers". Prior to calculating a sum score, some items were reversed so that a high score indicated positive attitudes toward bicyclists using the road.

Cronbach's α was estimated to .69. This value is lower than the convention of .70 (DeVellis, 2003), but α is sensitive to the number of items in a scale. According to Pallant (2010), it is not uncommon to find α values as low as .50 when using short scales (e.g., less

than 10 items). In such instances, it may be appropriate to report the mean inter-item correlation, which, according to Briggs and Cheek (1986), should be between .20 and .40. The attitudes scale consisted of only five items, between which there was a mean inter-item correlation of .31. A principal components analysis was performed on the five items of the attitudes scale in order to investigate how many dimensions or underlying factors were being measured by the scale. Kaiser's criterion, the scree test (Catell, 1966) and parallel analysis (Horn, 1965) supported the extraction of only one component. The one-component solution explained 45.09 % of the variance (see Appendix C).

Aggressive and considerate behavior. Drivers' behavior toward bicyclists were measured on two separate scales, one measuring prevalence of aggressive behavior, the other measuring prevalence of considerate behavior. Both scales were in Norwegian and developed by the Institute of Transport Economics (Fyhri et al., 2012).

On the aggressive behavior scale, participants were asked to rate the prevalence of their own aggressive behavior toward bicyclists during the last year. On a scale from one (never) to four (many times) they were asked to indicate how often they had yelled at a bicyclist, honked the car horn at a bicyclist, displayed negative gestures to a bicyclist, and squeezed the car in front of a bicyclist so that he or she had to stop. A sum score was calculated and Cronbach's α was estimated to .62, which was considered satisfactory, given that the scale consisted of only four items with a mean inter-item correlation of .33. A principal components analysis was performed in order to determine how many underlying dimensions or factors were measured by the scale (see Appendix D). Kaiser's criterion, the scree test (Catell, 1966) and parallel analysis (Horn, 1965) supported the extraction of only one component. The one-component solution explained 49.66 % of the variance.

On the nine-item considerate behavior scale, participants were asked to rate, on a scale from one (always) to five (never), how often they perform various considerate behaviors toward bicyclists, such as "Makes sure that there is at least 1.5 meters distance to bicyclists when you pass them" and "Tries to achieve eye contact with bicyclists at intersections". Items were reversed and recoded so that a high score indicated high prevalence of considerate behavior. A sum score was calculated and Cronbach's α was estimated to .68. Principal components analysis revealed a three-factor solution that explained 55.61 % of the variance, with the three components explaining 29.17 %, 13.66 % and 12.77 % respectively (see Appendix E). The pattern matrix, showing the rotated factor loadings with Oblimin rotation, did display a quite simple structure (see Thurstone, 1947), but did not allow for a clear

theoretical distinction between the factors. However, a bivariate correlation analysis revealed that the three factors correlated quite similarly with the other constructs in the study (see Table 2).

Table 2

Correlations Between the Three Factors Underlying the Considerate Behavior Scale and Attitudes, Extraversion, Neuroticism and Aggressive Behavior

Measure	F ₁	F ₂	F ₃
Attitudes	.215**	.242**	.223**
Extraversion	.052	.037	.139**
Neuroticism	-.177**	-.019	-.111**

Note. ** $p < .01$

The considerate behavior scale may, rather than a reflective index, be regarded as a formative index of self-reported behaviors that in sum provides a measure of drivers' considerate behavior toward bicyclists. As such, it was deemed meaningful to calculate a sum score, even though the principal components analysis indicated a three-factor solution.

Methods of Analysis

Descriptive statistics (e.g., means, standard deviations and Cronbach's α) were calculated using SPSS version 20. SPSS was also employed to perform bivariate correlation analyses and principal components analyses. Bartlett's test of sphericity (Bartlett, 1954) and the Kaiser-Meyer-Olkin measure of sampling adequacy (Kaiser, 1970, 1974) were used to assess the factorability of the data. In conjunction with the principal components analyses, Horn's (1965) parallel analysis was performed to aid in determining the correct number of factors to extract. The study's hypotheses of mediation and moderation were tested by using multiple hierarchical regression analysis with SPSS. Underlying assumptions (e.g., normality, linearity and homoscedasticity) of the employed methods of analysis were tested with SPSS. Tests of normality included use of the Kolmogorov-Smirnov and Shapiro-Wilks statistics.

Mediation analysis. Mediation, or indirect effects, comprises a situation in which the effect of a variable X on a variable Y is explained, completely or partially, by one or more intervening variables, or mediators (Shrout & Bolger, 2002). A variable may be termed a mediator when it explains the relationship between the predictor and the criterion (Baron &

Kenny, 1986). Mediation models are quite common in the field of psychology. For example, cognitive psychologists have advocated that attentional processes mediate the effect of stimuli on behavior (e.g., Stacy, Leight & Weingardt, 1994), while social psychologists have maintained that intentions function as a mediator between attitudes and behavior (e.g., Azjen & Fishbein, 1980). Mediation analyses may be considered especially serviceable in psychology, since they have the potential of explaining the processes by which different variables are related (MacKinnon, Lockwood, Hoffman, West & Sheets, 2002, p. 100).

In their major review, MacKinnon et al. (2002) identified 14 different methods designed to test mediation. The basic, and by far most popular method, is the one offered by Baron and Kenny (1986) (Iacobucci, Saldanha & Deng, 2007), often referred to as the causal step strategy (Preacher & Hayes, 2008). According to Iacobucci et al. (2007), this four-step strategy involves fitting three regression models to the data: (a) $M = \beta_1 + aX + \epsilon_1$, (b) $Y = \beta_2 + cX + \epsilon_2$, and (c) $Y = \beta_3 + c'X + bM + \epsilon_3$. Evidence for mediation is likely if there is a linear relationship between the independent variable (X) and the mediator (M), as well as between the independent variable (X) and the dependent variable (Y), at the same time as the mediator (M) contributes in predicting the dependent variable (Y) and the direct effect of the independent variable (X) on the dependent variable (Y) significantly decreases when the effect of the mediator (M) is controlled for. There has, however, been some debate among researchers as to whether it is necessary to establish a significant relationship between the independent and dependent variables. According to Kenny, Kashy and Bolger (1998, p. 259), this step is important in that it "establishes that there is an effect that may be mediated". Others (e.g., Collins, Graham & Flaherty, 1998; MacKinnon, 2000; MacKinnon, Krull & Lockwood, 2000) have argued that mediation may occur even though one is unable to establish a significant total effect of the independent variable(s) on the dependent variable.

Obtaining a statistically significant indirect effect is a prerequisite for claiming mediation. Until recently, few researchers have conducted formal significance tests of indirect effects (Preacher & Hayes, 2004). According to Preacher and Hayes (2004), there may be two main reasons for that: (a) the necessity of a statistically significant indirect effect is not explicitly stated in Baron and Kenny's (1986) procedure, and (b) statistical computer software, like SPSS and SAS, does not automatically provide a test of the null hypothesis claiming that the indirect effect equals zero.

One method for testing the significance of indirect effects is Sobel's (1982) large-sample test. This test has its limitations as a result of being based on an assumption of normal distributions. Therefore, several authors (e.g., Preacher & Hayes, 2004, 2008; Shrout &

Bolger, 2002) have argued in favor of employing a non-parametric bootstrapping procedure, in which a large number of samples, of the same size as the original sample, are drawn from the data. Bootstrapping does not rest on an assumption of normal distributions, and instead involves calculating the indirect effect in every resampled data set, which in turn makes it possible to construct confidence intervals for the indirect effect (Preacher & Hayes, 2008). Preacher and Hayes (2008, p. 886) conclude that "[b]ootstrapping provides the most powerful and reasonable method of obtaining confidence intervals for specific indirect effects under most conditions".

In the present study, mediation analyses were conducted according to Baron and Kenny's (1986) stepwise procedure. Significance tests of indirect effects were conducted by employing Preacher and Hayes' SPSS macro for multiple mediation (Preacher & Hayes, 2008). Some authors have emphasized that structural equation models outperform approaches to mediation analysis based on regressions (such as Baron and Kenny's procedure) (e.g., Iacobucci et al., 2007). Structural equation modeling employs the complete mediation model as its baseline model for mediation, unlike the Baron and Kenny approach which is based on partial mediation as its focal mediation paradigm (James, Mulaik & Brett, 2006). Partial mediation is considered to be the primary explanatory mediation model in the field of psychology (Baron & Kenny, 1986; James et al., 2006). James et al. (2006) compared the two approaches and found that they performed near identically when testing for partial mediation. The present study hypothesizes partial mediation, and Baron and Kenny's procedure, based on regression analysis, was therefore deemed serviceable.

Moderation analysis. Moderation (interaction) implies that the relationship between two variables changes as a result of the effect of a third variable (Baron & Kenny, 1986). Hence, a moderator is a variable that affects the direction and/or strength of the relationship between an independent and a dependent variable (Baron & Kenny, 1986, p. 1174). Proposing that personality moderates the effect of attitudes on behavior is equivalent to claiming that personality and attitudes interact in their effect on behavior (Keith, 2006).

The present study's moderation hypotheses were tested through hierarchical (sequential) regression analyses. The first step of a moderation analysis is to construct an interaction variable by multiplying the independent variable (X) with the proposed mediator (M). Next, the hierarchical regression is performed by entering variables in two steps/models. Evidence of moderation exists when R^2 increases when the interaction variable is included, given that this increase is statistically significant.

Results

Preliminary Analyses

Descriptive statistics for the study variables (means, standard deviations, range, and measures for skewness and kurtosis) were calculated in order to describe the variables' psychometric properties. Basic psychometric properties of the study variables are presented in Table 3.

Table 3

Psychometric Properties of the Study Variables

Variable	N	M	SD	Range		Skew	Kurtosis	α
				Potential	Actual			
Extraversion	1022	4.40	0.97	1-7	1.0-7.0	-0.15	0.06	.78
Neuroticism	1033	2.59	0.93	1-7	1.0-6.1	0.60	0.13	.79
Attitudes	1100	4.54	1.21	1-7	1.0-7.0	-0.46	0.01	.69
Aggressive behavior	1084	1.19	0.35	1-4	1.0-4.0	2.99	13.30	.62
Considerate behavior	1087	4.13	0.48	1-5	1.7-5.0	-0.82	1.48	.68

Note. The variation in *sample size* is a result of some participants not answering all questions.

As shown in Table 3, the sample scored overall higher on extraversion ($M = 4.40$, $SD = 0.97$) than on neuroticism ($M = 2.59$, $SD = 0.93$). Obtained values for skewness and kurtosis indicated that the personality variables were near normally distributed. Near normal distributions were also found by inspecting histograms, normal probability plots (normal q-q plots) and detrended normal q-q plots. Inspection of the scatter plots revealed no serious violation of the assumption of linearity, while there was only a small difference between the mean scores and 5 % trimmed mean scores, indicating that extreme scores or outliers had little influence on the obtained mean scores. The residual scatter plots did not suggest violation of the assumption of homoscedasticity.

In a similar manner, preliminary analyses of the attitudes variable did not reveal any serious violations of the assumptions of normality, linearity and homoscedasticity. There was, however, a tendency toward negative skewness (-0.46), suggesting that scores on the attitudes scale clustered somewhat at the high end of the scale. In other words, drivers expressed more positive than negative attitudes toward sharing the road with bicyclists ($M = 4.54$, $SD = 1.21$).

Overall, drivers scored low on the aggressive behavior scale ($M = 1.19$, $SD = 0.35$), suggesting that the prevalence of aggressive behavior toward bicyclists was relatively low. As a result, preliminary analyses displayed a quite substantial positive skewness (2.99). Furthermore, the kurtosis value for the aggressive behavior scale was estimated to 13.30, indicating that the distribution was quite peaked rather than flat. Not surprisingly, inspections of the histogram, normal q-q plot and detrended q-q plot suggested violation of the assumption of normality. This was further supported by both the Kolmogorov-Smirnov and Shapiro-Wilk statistics reaching statistical significance ($p < .000$). It was, however, decided not to apply a transformation to the aggressive behavior variable. Several authors have advocated that neither skewness nor kurtosis make a substantial difference when one operates with reasonably large samples, and that the question of whether to transform skewed data is imperative only for small sample sizes, given that the central limit theorem secures a normal sampling distribution in large samples (e.g., Field, 2009; Games, 1984; Tabachnick & Fidell, 2007). Moreover, the aggressive behavior scale measures a phenomenon that one might expect to be relatively rare in the general population, and thus not normally distributed. As such, the skewed data may reflect the nature of the construct being measured, rather than being an indication of a flawed scale (Pallant, 2010).

Preliminary analyses revealed that the considerate behavior scale was negatively skewed (-0.82), indicating that drivers reported a rather high quantity of considerate behavior toward bicyclists ($M = 4.13$, $SD = 0.48$). Not surprisingly, the considerate behavior data clustered at the opposite end of the scale compared to the aggressive behavior data.

All variables were deemed suitable for further analysis with parametric tests.

Bivariate Correlation Analyses

Bivariate correlation analyses were conducted in order to explore the associations between the study variables. Correlations between the personality variables, attitudes and the behavior variables were generally small, but most were statistically significant. Correlations between the variables are presented in Table 4.

Table 4

Correlations Between the Study Variables

Variable	1	2	3	4	5
1. Extraversion	-				
2. Neuroticism	-.34**	-			
3. Attitudes	.05	-.12**	-		
4. Aggressive behavior	.09**	.07*	-.37**	-	
5. Considerate behavior	.11**	-.17**	.31**	-.28**	-

Note. * $p < .05$; ** $p < .01$

As shown in Table 4, there was a positive correlation between extraversion and aggressive behavior ($r = .09, p < .01$), with high levels of extraversion associated with higher levels of aggressive behavior. Interestingly, extraversion was also positively correlated with considerate behavior ($r = .11, p < .01$). Participants who scored high on extraversion tended to have more positive attitudes toward bicyclists using the road than those who scored low on extraversion ($r = .05$), but this correlation was non-significant. Neuroticism was positively correlated with aggressive behavior ($r = .07, p < .05$) and negatively correlated with considerate behavior ($r = -.17, p < .01$). High levels of neuroticism were thus associated with higher levels of aggressive behavior and lower levels of considerate behavior. Participants who scored high on neuroticism also expressed less positive attitudes toward bicyclists using the road ($r = -.12, p < .01$). Attitudes were negatively correlated with aggressive behavior ($r = -.37, p < .01$) and positively correlated with considerate behavior ($r = .31, p < .01$). Thus, not surprisingly, participants who expressed positive attitudes toward bicyclists using the road reported less aggressive behavior and more considerate behavior toward bicyclists than those who expressed less positive attitudes.

Mediation Analyses

Mediation analysis 1: Aggressive behavior. In the present study, Baron and Kenny's (1986) four-step procedure was employed in order to test the hypothesis that extraversion and neuroticism have positive effects on aggressive behavior and that these effects are partially mediated by attitudes. The first step was to investigate whether the independent variables (extraversion and neuroticism) were related to the dependent variable (aggressive behavior). Through a regression model, it was found that both extraversion ($b = .044, \beta = .122, p < .001$) and neuroticism ($b = .041, \beta = .108, p < .001$) were significantly related to aggressive

behavior. Together, the personality variables explained 1.8 % of the variance in aggressive behavior ($R^2 = .018$).

The second step was to conduct another regression analysis in order to investigate whether the independent variables were related to the proposed mediator (attitudes). It was found that extraversion was not significantly related to attitudes ($b = .014$, $\beta = .011$, $p = .746$).

Neuroticism, however, was significantly related to attitudes ($b = -.149$, $\beta = -.114$, $p < .001$).

The personality variables explained 1.4 % of the variance in attitudes ($R^2 = .014$).

A hierarchical (sequential) multiple regression was conducted in the third step of the analysis. In model 1, extraversion and neuroticism were entered as independent variables and aggressive behavior as dependent variable. In model 2, attitudes was included as an independent variable (in addition to the personality variables), while aggressive behavior was kept as dependent variable. It was found that the proposed mediator (attitudes) was significantly related to aggressive behavior when the personality variables were held constant ($b = -.108$, $\beta = -.371$, $p < .001$).

The fourth step of the analysis aimed to determine whether the data were consistent with complete or partial mediation. The second step in the analysis showed that extraversion was not significantly related to attitudes. Thus, there was no evidence to support that the effect of extraversion on aggressive behavior was mediated by attitudes. As shown in Table 5, the effect of neuroticism on aggressive behavior was reduced when attitudes was controlled for. The effect was, however, still significant and non-zero. A significance test, using a bootstrapping procedure with Preacher and Hayes' (2008) SPSS macro, showed that the indirect effect of neuroticism on aggressive behavior was significant (95 % CI [.0067, .0264]). Thus, and as hypothesized, the effect of neuroticism on aggressive behavior was partially mediated by attitudes. Direct and indirect (mediated) pathways of extraversion and neuroticism on aggressive behavior is shown in Figure 3.

Table 5

Effects of the Personality Variables on Aggressive Behavior, Without (Model 1) and With (Model 2) the Mediator Variable (Attitudes)

	Model 1		Model 2	
	b (se)	β	b (se)	β
Extraversion	.044 (0.012)***	.122***	.046 (0.011)***	.126***
Neuroticism	.041 (0.013)***	.108***	.025 (0.012)*	.066*
Attitudes			-.108 (0.009)***	-.371***
R^2	.018		.153	

Note. * $p < .05$; *** $p < .001$

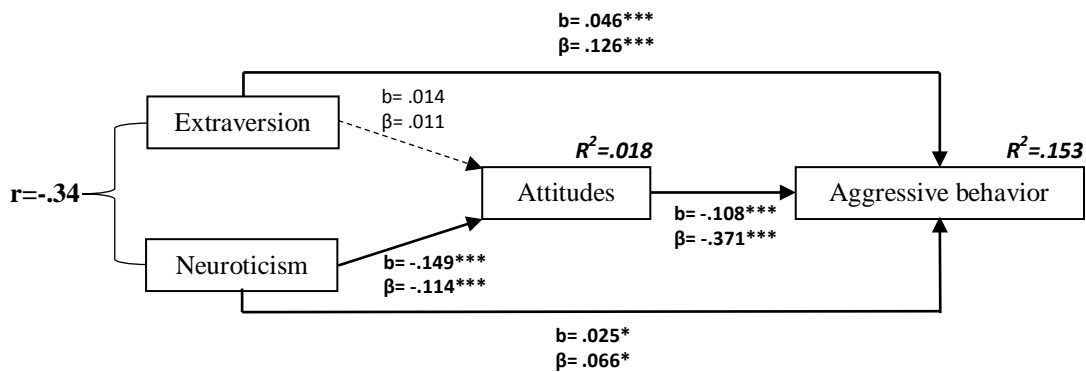


Figure 3. Path diagram of the aggressive behavior mediation model.* $p < .05$; *** $p < .001$. Solid lines indicate significant relationships. Dotted line indicates non-significant relationship.

Mediation analysis 2: Considerate behavior. The hypothesis that extraversion and neuroticism have negative effects on considerate behavior and that these effects are partially mediated by attitudes was, like mediation analysis 1, tested by employing Baron and Kenny's (1986) four-step procedure. In the first step of the analysis, it was found that extraversion had a positive direct effect on considerate behavior, although the effect was non-significant given an alpha level of .05 ($b = .031$, $\beta = .062$, $p = .062$). Neuroticism, however, had a significant direct negative effect on considerate behavior ($b = -.075$, $\beta = -.145$, $p < .001$). The personality variables explained 3.1 % of the variance in considerate behavior ($R^2 = .031$).

The second step of mediation analysis 2 was identical to the corresponding step in mediation analysis 1, where it was established that neuroticism was significantly related to

attitudes ($b = -.149$, $\beta = -.114$, $p < .001$), while extraversion was not ($b = .014$, $\beta = .011$, $p = .746$). Extraversion and neuroticism explained 1.4 % of the variance in attitudes ($R^2 = .014$).

A hierarchical (sequential) multiple regression was employed in the third step of the analysis. Extraversion and neuroticism was entered as independent variables in model 1, with considerate behavior as dependent variable. The attitude variable was added as an independent variable in model 2. Controlled for the personality variables, the proposed mediator (attitudes) had a significant positive effect on considerate behavior ($b = .116$, $\beta = .291$, $p < .001$).

As demonstrated in the second step of the analysis, extraversion was not significantly related to the proposed mediator (attitudes) and, thus, there was no evidence to support that the effect of extraversion on considerate behavior was mediated by attitudes. Furthermore, as shown in the first step of the analysis, extraversion had no significant direct effect on considerate behavior. However, as shown in Table 6, the effect of neuroticism on considerate behavior was reduced when the mediator (attitudes) was controlled for, yet the effect was still significant and non-zero. Using a bootstrapping procedure with Preacher and Hayes' (2008) SPSS macro, it was found that the indirect effect of neuroticism on considerate behavior was significant (95 % CI [-.0268, -.0061]). This supports the hypothesis that the effect of neuroticism on considerate behavior is partially mediated by attitudes. Direct and indirect (mediated) pathways of extraversion and neuroticism on considerate behavior is shown in Figure 4.

Table 6

Effects of the Personality Variables on Considerate Behavior, Without (Model 1) and With (Model 2) the Mediator Variable (Attitudes)

	Model 1		Model 2	
	b (se)	β	b (se)	β
Extraversion	.031 (0.016)	.062	.029 (0.016)	.059
Neuroticism	-.075 (0.017)***	-.145***	-.058 (0.016)***	-.111***
Attitudes			.116 (0.012)***	.291***
R^2	.031		.114	

Note. *** $p < .001$

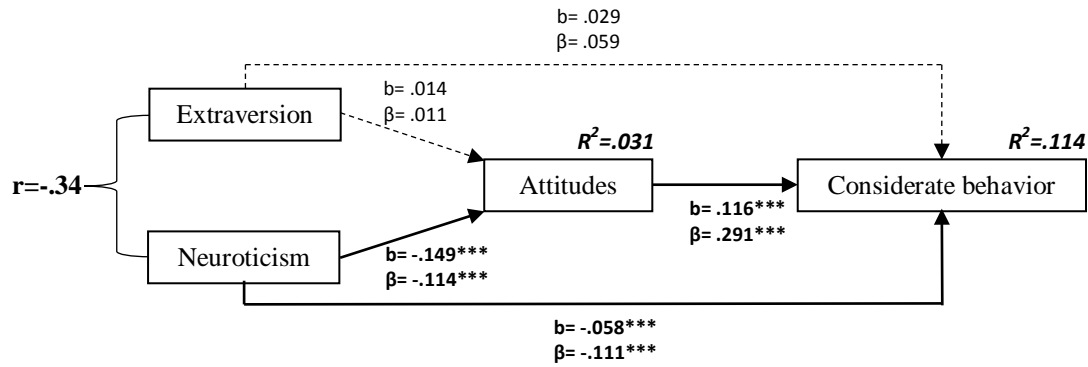


Figure 4. Path diagram of the considerate behavior mediation model. *** $p < .001$. Solid lines indicate significant relationships. Dotted lines indicate non-significant relationships.

Moderation Analyses

Moderation analysis 1: Aggressive behavior. The first moderation analysis aimed to determine whether extraversion and neuroticism moderated the effect of attitudes on aggressive behavior. First, it was investigated whether extraversion moderated the effect of attitudes on aggressive behavior. An interaction variable (attitudes x extraversion) was constructed, and entered in the second model in a hierarchical regression, with aggressive behavior as dependent variable. There was no significant increase in R^2 ($\Delta R^2 = .001, p = .241$) and, hence, no evidence to support an interaction effect of extraversion and attitudes on aggressive behavior.

Second, it was tested whether neuroticism moderated the effect of attitudes on aggressive behavior. Another interaction variable (attitudes x neuroticism) was constructed and entered in a regression analysis. There was no increase in R^2 as a result of the interaction variable being included ($\Delta R^2 = .000, p = .597$). Hence, evidence did not support the hypothesis that neuroticism and attitudes interact in their effect on behavior.

Moderation analysis 2: Considerate behavior. The second moderation analysis tested whether extraversion and neuroticism moderated the effect of attitudes on considerate behavior. Moderation analysis 2 was conducted with the same procedure as moderation analysis 1. First, it was found that the effect of attitudes on considerate behavior was moderated by extraversion, and that this interaction effect was statistically significant ($p < .01$). R^2 increased significantly when the interaction variable (attitudes x extraversion) was included in the hierarchical regression ($\Delta R^2 = .008$) (see Table 7). Based on this regression

model, Figure 5 illustrates that the effect of attitudes on considerate behavior was stronger for those who scored low on extraversion compared to those who scored high on extraversion. As hypothesized, extraversion moderated the effect of attitudes on considerate behavior.

Table 7

Effect of the Interaction Between Extraversion and Attitudes on Considerate Behavior, Without (Model 1) and With (Model 2) the Interaction Variable (Attitudes x Extraversion)

	Model 1		Model 2	
	b (se)	β	b (se)	β
Attitudes	.120 (0.012)***	.302***	.260 (0.054)***	.655***
Extraversion	.048 (0.015)***	.096***	.189 (0.055)***	.380***
Attitudes x extraversion			-.031 (0.012)**	-.470**
R^2	.103		.110	
ΔR^2			.006**	

Note. ** $p < .01$; *** $p < .001$

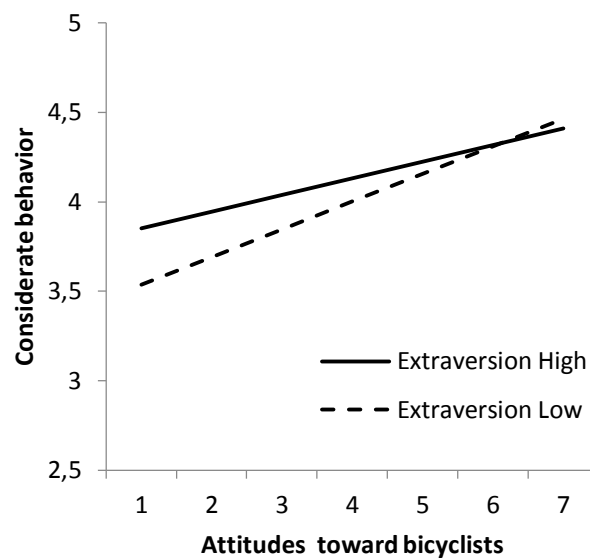


Figure 5. Predicted scores on considerate behavior from attitudes toward bicyclists using the road, separately for high ($M + 1 SD$) vs. low ($M - 1 SD$) levels of extraversion.

For neuroticism, it was no significant increase in R^2 ($\Delta R^2 = .001$, $p = .408$) when the interaction variable was included in the regression analysis and, hence, no evidence to support an interaction effect of neuroticism and attitudes on considerate behavior.

Discussion

The present study aimed to explore the relationship between personality and driving behavior by investigating the role of drivers' level of extraversion and neuroticism in their aggressive and considerate behavior toward bicyclists. It was hypothesized that extraversion and neuroticism have positive effects on aggressive behavior, and that these effects are partially mediated by drivers' attitudes toward bicyclists using the roads. Second, it was hypothesized that extraversion and neuroticism have negative effects on considerate behavior, and that these effects are, as well, partially mediated by attitudes. Third, it was assumed that the effects of attitudes on behavior (aggressive and considerate) are moderated by extraversion and neuroticism.

Convergent with Shinar's (1998) frustration-aggression model and in line with previous research, the present study points to significant associations between personality variables and driving behavior, even though these associations may be characterized as small.

The Role of Extraversion in Drivers' Behavior Toward Bicyclists

Extraversion and aggressive driving behavior. As hypothesized and in line with previous research on aggressive driving, risky driving and/or accident involvement (e.g., Benfield et al., 2007; Clarke & Robertson, 2006; Jonah, 1997; Lajunen, 2001; Olstedal & Rundmo, 2006), drivers who scored high on extraversion (extraverts) tended to report higher levels of aggressive behavior toward bicyclists than drivers who scored low on extraversion (introverts). The size of the positive association between extraversion and aggressive behavior was relatively small, possibly and at least partly, because the extraversion items in the Big Five Inventory do not measure sensation seeking or excitement seeking (Engvik & Føllesdal, 2005), a facet that has been thoroughly shown to correlate positively with aggressive driving behavior (see e.g., Jonah, 1997), and that is included in other measures of extraversion (such as in the NEO Personality Inventory).

It is unclear which mechanisms underlie the positive association between extraversion and aggressive driving behavior. The facet assertiveness, which involves social ascendancy and forcefulness of expression (Costa & McCrae, 1992), may be of importance. Assertive people tend to take charge, seek to influence others, take control and try to lead others (Costa & McCrae, 1992). It may be that such dispositions contribute to lower the extraverted driver's threshold for aggression, at least in traffic situations in which the driver perceives the presence of a conflict with a bicyclist. Another possibility is the facet activity, i.e., the person's pace of living. Active people are always busy, they are always on the go, and attempt

to manage several tasks simultaneously (Costa & McCrae, 1992). Employing the frustration-aggression framework, it is not inconceivable that drivers who frequently experience time pressure may have an elevated risk of having their personal mobility needs frustrated, thus making them particularly prone to react with aggression. Extraversion concerns the quantity and intensity of energy directed outwards into the social world (Costa & McCrae, 1992). Having a high baseline energy level may increase the psychological system's risk of reaching a disequilibrium as a result of frustration, which, in turn, may increase the amount of aggressive behavior. Extraverts also tend to seek and vary self-stimulation much more rapidly and intensively than introverts (Clarke & Robertson, 2005; Koelega, 1992), which may increase aggressive behavior, insofar that aggressive driving is perceived as a form of self-stimulation.

The present study found no evidence to support an association between extraversion and attitudes. This finding was counter-hypothetical and somewhat unexpected, given that the five-factor theory of personality postulates that basic personality dimensions (including extraversion) affect the individual's characteristic adaptations (which includes attitudes) (McCrae & Costa, 1996, 2008). On the other hand, several authors have been unable to establish a significant association between extraversion and attitudes. Siegman (1963) reviewed several studies aimed at investigating whether the introversion-extraversion dimension was a significant source of variance in "tough-minded" attitudes, religiosity and antisocial behavior. He concluded that evidence did not support a correlation between extraversion and tough-minded or authoritarian attitudes. Similarly, Pearson and Sheffield (1976) were unable to establish a significant correlation between extraversion and social attitude variables. The lack of a significant association between extraversion and attitudes means that the present study found no evidence to support the hypothesis that the effect of extraversion on aggressive behavior is mediated by attitudes, even though the study found a significant positive relationship between extraversion and aggressive behavior, as well as a significant negative relationship between attitudes and aggressive behavior (indicating that positive attitudes toward bicyclists on the road was associated with less aggressive behavior). No evidence was found for an interaction effect of extraversion and attitudes on aggressive behavior.

Extraversion and considerate driving behavior. Unexpectedly, the present study found that those who scored high on extraversion scored higher on considerate behavior than those who scored low on extraversion. This finding is interesting since extraversion also correlated

positively with aggressive behavior. One may not expect the same personality trait to be associated with behaving both aggressively and considerately. Positive associations between extraversion and both aggressive and considerate behavior may thus, at first glance, manifest itself as inconsistent. Lajunen (2001) argues that such seemingly inconsistent findings may emerge as a result of the instrument chosen to measure the trait. Some instruments measure personality solely on a superordinate trait level (e.g., the Big Five Inventory), while others include subscales for different facets of the trait in question (e.g., the NEO Personality Inventory). Even though extraversion contains facets one would expect to correlate negatively with considerate behavior (e.g., assertiveness and activity), extraversion also includes facets that may be more compatible with high scores on considerate behavior, such as warmth (interest in and friendliness toward others) and positive emotions (tendency to experience positive emotions) (Costa & McCrae, 1992). Even though the Big Five Inventory does not measure warmth and positive emotions directly (Engvik & Føllesdal, 2005), the drivers in the present study were asked to rate themselves on items such as "Is outgoing and social" and "Creates a lot of enthusiasm". Iverson and Erwin (1997) found that positive emotions were negatively correlated with occupational accidents, and Loo (1979) reported that the positive relationship between extraversion and risky driving disappeared when sociability was controlled for. Finding significant positive correlations between extraversion and both aggressive and considerate behavior may thus be a result of the Big Five Inventory measuring extraversion without making distinctions between different facets².

The direct and significant positive association between extraversion and considerate behavior lost its statistical significance when both extraversion and neuroticism were included as predictors in the same regression analysis. As such, one may argue that there is a stronger relationship between extraversion and aggressive behavior than between extraversion and considerate behavior (the positive association between extraversion and aggressive behavior remained significant when subjected to regression analysis). Neither did extraversion have a significant indirect effect on considerate behavior through attitudes, since there was no evidence for a significant relationship between extraversion and attitudes. As such, the present study found no evidence to support the hypothesis that the effect of extraversion on considerate behavior is mediated by attitudes.

² This interpretation is supported in the present study's data. The extraversion item "Is outgoing and social" correlated positively with considerate behavior ($r = .14, p < .01$), but did not show a significant correlation with aggressive behavior. The extraversion item "Is self-assertive" displayed an opposite pattern. It correlated positively with aggressive behavior ($r = .10, p < .01$), but displayed no significant correlation with considerate behavior.

However, it was found that extraversion had a moderating effect on the relationship between attitudes and considerate behavior. The effect of attitudes on considerate behavior was stronger for those who scored low on extraversion compared to those who scored high on extraversion. It may be that a personality trait, in this case extraversion, can somewhat "override" attitudes as a factor influencing behavior when the individual scores high on that trait. According to the five-factor theory of personality (McCrae & Costa, 1996, 2008), traits (basic tendencies) are largely biologically based and thus more fundamental than attitudes, which reside within the concept of characteristic adaptations and are believed to be more sensitive to external influences and cultural conditioning. Hence, the effect of attitudes on behavior may be reduced when the trait is more "extreme". Also, introverts are more introspective than extraverts, and it may be that introverts' behavior is more influenced by internal attitudes than extraverts' behavior, which may be more affected by external influences such as social pressure.

It must be noted that the size of the moderating effect of extraversion on the relationship between attitudes and considerate behavior was quite small, even though it was significant. This may be due to the interaction effect in fact being small, or it may reflect the great difficulties of identifying interaction effects in non-experimental studies (see McClelland & Judd, 1993). Of course, a combination of the two is also possible. Interaction effects in social science research typically explain 1-3 % of the total variance (see e.g., Champoux & Peters, 1987; Chaplin, 1991). Zedeck (1971, p. 305) proclaimed that "moderators are as elusive as suppressor variables", and according to Evans (1985), an interaction effect should be considered important even though it explains only 1 % of the total variance. Hence, even though the interaction effect obtained in the present study must be characterized as small, it may still be considered meaningful and important.

The Role of Neuroticism in Drivers' Behavior Toward Bicyclists

Neuroticism and aggressive driving behavior. As hypothesized, emotionally unstable drivers (high neuroticism) reported more aggressive behavior toward bicyclists than emotionally stable drivers (low neuroticism).

Different aspects of neuroticism may underlie the positive association between neuroticism and aggressive behavior toward bicyclists. First, individuals who score high on neuroticism are generally prone to psychological distress and particularly vulnerable to stress. Neuroticism has been identified as a strong predictor of driver stress (Matthews, Dorn & Glendon, 1991), possibly because neuroticism is associated with ineffective coping strategies (Dorn &

Matthews, 1992). Individuals who score high on neuroticism report more frequent use of aggressive and confrontative approaches to coping than others (Galovski & Blanchard, 2004). Reactions to stress include decreased cognitive and performance capacities (Steffy, Jones, Murphy & Kunz, 1986), and highly neurotic individuals may be more stress reactive than others in traffic (Clarke & Robertson, 2005). As such, neurotics may respond particularly negatively in the presence of environmental stressors. Such a notion is in line with Shinar's (1998) frustration-aggression model, which postulates that certain aspects of the driver's personality interact with environmental factors to determine whether an aggressive disposition, and subsequently aggressive behavior, occurs. Aggressive driving as a result of an elevated stress baseline is also in accordance with personal maladjustment theory, which suggests that aggressive drivers are characterized by being particularly prone to stress (Mayer & Treat, 1977; Selzer et al., 1968). Second, high scores on neuroticism may be linked to anger. Moodiness and being temperamental constitute central aspects of neuroticism, and emotionally unstable individuals are more prone to anger than emotionally stable individuals (Bone & Mowen, 2006). Anger has been thoroughly linked to aggressive driving (e.g., Deffenbacher et al., 2003; Deffenbacher et al., 2000). Third, neurotic individuals may frequently experience impatience, tension, nervousness and irritation (Carver & Scheier, 1999). In a traffic context, impatience and elevated irritation may lower the driver's threshold for aggressive behavior, as predicted by Shinar's (1998) frustration-aggression model.

As expected, the present study found a negative association between drivers' neuroticism and their attitudes toward bicyclists using the road. Hence, drivers who scored high on neuroticism reported having less positive attitudes toward bicyclists using the road than drivers who scored low on neuroticism. This finding is in accordance with the five-factor theory of personality in that basic tendencies (including neuroticism) affects characteristic adaptations (including attitudes), and in line with Ullerberg and Rundmo (2003) who found a negative relationship between aggressiveness (facet under neuroticism) and attitudes toward traffic safety.

The present study implies that more neurotic drivers have less positive attitudes toward bicyclists using the road which, in turn, increases their aggressive behavior toward bicyclists. This is comparable to Ullerberg and Rundmo (2003) who found that the association between aggression and anxiety (facets under neuroticism) and risky driving behavior was mediated by attitudes. However, in the present study, the effect of neuroticism on behavior was *partially* mediated, meaning that neuroticism had a direct effect on behavior, independent from the indirect effect through attitudes. In partial mediation, the mediator explains some, but not all,

of the estimated association between the independent variable and the dependent variable. That is, attitudes toward bicyclists on the road explains some, but not all, of the association between drivers' neuroticism and their aggressive behavior toward bicyclists.

Neuroticism and considerate driving behavior. As expected, the present study found that emotionally unstable drivers reported less considerate behavior toward bicyclists than emotionally stable drivers. Even though aggressive and considerate behavior may not be mutually exclusive behavioral categories (Özkan & Lajunen, 2005), it is not surprising to find a negative relationship between neuroticism and considerate behavior, given that neuroticism has been thoroughly linked to antisocial behavior in the research literature (e.g., Allsopp & Feldman, 1974; Miller & Lynam, 2001; Miller, Lynam & Leukefeld, 2003). However, one could expect certain aspects of the neuroticism dimension to correlate positively with considerate behavior. For instance, the tendency to experience anxiety and nervousness could lead people to behave particularly cautiously. Ulleberg and Rundmo (2003), for example, found a negative correlation between anxiety and risk-taking behavior in traffic. It may not be unreasonable to expect anxious drivers to be particularly aware of the dangers linked to traffic situations in which they have to interact with bicyclists. If not to act prosocially, the motivation might be to avoid conflicts and accidents. Even so, the present study did not find such a relationship between neuroticism and considerate behavior, perhaps because neuroticism was measured using the Big Five Inventory, which does not distinguish between different facets of neuroticism.

The relationship between drivers' neuroticism and attitudes toward bicyclists using the road was negative, and regression analysis showed that the effect of neuroticism on considerate behavior, as hypothesized, was partially mediated by attitudes. More neurotic drivers expressed less positive attitudes toward bicyclists using the road than less neurotic drivers, which in turn was associated with decreased considerate behavior toward bicyclists for drivers who scored high on neuroticism compared to drivers who scored low on neuroticism.

Methodological Issues

Sample. To what extent the sample reflects the true characteristics of the targeted population (i.e., representativity) is a major concern in social sciences research. First, the present study is based on an Internet survey. Such surveys reach a large number of potential respondents and can be administered rapidly without great costs. However, surveys in general, and Internet surveys in particular, have their inherent limitations. Especially, nonresponse bias

is of concern. Nonresponse bias becomes a problem when those who respond systematically differ from those who do not. As such, obtained results may misrepresent the targeted population (Hudson, Seah, Hite & Haab, 2004). Even though Internet surveys have many advantages, they do require participants to have Internet access and be willing to submit personal information over the Internet (Hudson et al., 2004). Moreover, it is difficult to estimate to what extent nonresponding may have biased the results because the researcher typically do not have much knowledge about those who do not respond. In the present study, the response rate was 24 %. However, it is not realistic to obtain a very high response rate in studies that rely on voluntary participation (Ulleberg, 2002b). Despite a quite low response rate, the sample must be characterized as large (1196 respondents) and participants' scores on the personality variables were near normally distributed. Thus, one may assume that nonresponding have not seriously biased the obtained results.

Second, the present sample represents a quite skewed gender distribution (28 % females, 72 % males). Studies have found that males tend to drive more aggressively than females (e.g., Lajunen & Parker, 2001; Miller, Azrael, Hemenway & Solop, 2002; Parker, Lajunen & Summala, 2002). Hence, one would expect the present study's results to be biased by an overestimation of the prevalence of aggressive driving. On the other hand, the Norwegian Travel Survey 2009 (Vågane, Brechan & Hjorthol, 2011) found that men accounted for 68 % of the traveled distance on the day of measurement. The present study would probably explain more variance in driving behavior if gender was included as an independent variable. The focus of the present study was, however, to investigate the role of personality. Costa, Terracciano and McCrae (2001) found that gender differences in personality are small, relative to individual variations within genders. Systematic gender differences in scores on the Big Five Inventory have been found, but these differences must be characterized as small (Engvik & Føllesdal, 2005; Srivastava, John, Gosling & Potter, 2003).

Third, drivers above the age of 55 constitute approximately half of the present sample, while Vågane et al. (2011) estimated that drivers above 55 are responsible for only 25 % of the total prevalence of driving in Norway. The drivers in the present study are thus likely to be older and more experienced than the average Norwegian driver. Consequently, one may expect the present study to somewhat underestimate the prevalence of aggressive driving, since studies have found that the tendency to behave aggressively in traffic decreases with age (e.g., Lajunen & Parker, 2001). Further, one could also expect an overestimation of considerate behavior since positive driving behavior typically increases with age (Özkan & Lajunen, 2005). However, age differences on personality scores on the Big Five Inventory are

generally relatively small, with the largest differences typically being a half standard deviation (Engvik & Føllesdal, 2005). Nevertheless, it seems reasonable to believe that, in the present study, the skewed age distribution among the drivers represents a greater threat to generalization than a relatively skewed gender distribution and a relatively low response rate.

Self-reported data. Social desirability, i.e., a respondent's tendency to provide answers that he or she believes are socially acceptable, has been identified as a possible source of bias, especially in survey research. Thus, social desirability is often treated as a separate variable researchers seek to control. For instance, research has found that drivers who described themselves as safety minded also scored high on social desirability (Lajunen & Summala, 1995). In the field of personality psychology, several authors have argued that social desirability constitutes a specific aspect of personality rather than being a source of bias, and that controlling for social desirability will in fact compromise a scale's validity (see Piedmont, 1998). It may, for instance, be difficult to meaningfully distinguish between need for approval (as a personality variable) and social desirability (as a control variable) (Piedmont, 1998).

The present study did not include a measure of social desirability, neither as a separate scale nor as specific items within other scales. Even so, social desirability is not believed to be a significant source of bias. First, respondents were guaranteed anonymity, and second, social desirability would probably be a greater threat to the results in studies based on observation in real-world traffic situations where drivers are aware that they are being observed (e.g., by other road users) (see Hatakka, 1998). Also, West, French, Kemp and Elander (1993) found significant associations between self-reported driving behavior and observed driving behavior.

Despite inherent limitations, self-reported data are serviceable when measuring personality and attitudes, since the researcher needs access to information that "resides within" the individuals. Driving behavior could alternatively, as mentioned, be measured through direct observation, but such an approach also has the disadvantage of being very time-consuming and thus practically impossible with a sample of 1196 drivers.

Measurement instruments, level of specificity and causality. Drivers' extraversion and neuroticism were measured using the Norwegian version of the Big Five Inventory. The Big Five Inventory has shown satisfactory reliability estimates both in American and a Norwegian sample (Engvik & Føllesdal, 2005). Drivers' attitudes toward bicyclists using the road and drivers' aggressive and considerate behavior toward bicyclists were measured using scales

newly developed by the Institute of Transport Economics in Oslo, Norway. These scales have not been validated to the same extent as the Big Five Inventory. In the present study, scores on the two behavioral scales proved to be quite skewed. This may have contributed to the present study obtaining relatively small effect sizes since there was quite little variance on the outcome variables to be explained. Skewed, non-normal distributions on the behavioral scales may, however, reflect the nature and prevalence of the constructs (behaviors) being measured, rather than reflecting flawed scales. Transformations could have been applied to the behavior variables, but were deemed unnecessary, particularly because skewness is considered a minor problem in large samples compared to smaller samples (see e.g., Field, 2009; Games, 1984; Tabachnick & Fidell, 2007). The attitudes scale and the behavior scales showed satisfactory psychometric properties, and were developed by experts at the Institute of Transport Economics especially for measuring drivers' attitudes and behavior toward bicyclists.

Ideally, all variables should be measured at the same level of specificity or abstraction in order to obtain the strongest possible relationships between the variables (see e.g., Ajzen & Fishbein, 1980). In the present study, the personality variables were measured at a high level of abstraction, while attitudes and behavior were measured much more specific, i.e., on a lower level of abstraction. That is, general personality dimensions were employed in conjunction with specific traffic attitudes and specific behaviors. It may be argued that such an approach may have influenced the obtained effect sizes and statistical significance values. Furthermore, measuring personality traits at a high level of abstraction with the Big Five Inventory may have made it more difficult to interpret the results than what could have been the case if personality was measured on a lower, facet level, e.g., using items from the NEO Personality Inventory measuring specific trait facets. However, there is evidence for substantial convergent and divergent validity between the Big Five Inventory and other assessment instruments measuring the traits in the five-factor personality framework (Rammstedt & John, 2005, 2007), and the present study aimed explicitly at investigating personality on a high level of abstraction.

As a theoretical framework, it has in the present study been assumed that personality traits are more fundamental than attitudes which, in turn, are more fundamental than behavior. That is, it is presupposed that traits influence attitudes which, in turn, influences behavior (see also Ulleberg & Rundmo, 2003). Personality traits reflect general tendencies and have a biological basis (McCrae & Costa, 1996, 2008), unlike attitudes which are more evaluative and refer to specific phenomena (Hogg & Vaughan, 2005; Ulleberg, 2002b). The relationship between attitudes and behavior may, however, be more complicated. Although it is reasonable to argue

that attitudes are more fundamental than behavior, some authors have opposed such a stance. For instance, Bem's (1967, 1972) self-perception theory postulates that behavior is more fundamental than attitudes in that attitudes are developed and shaped by people observing their own behavior and deciding that behavioral strategies must be a result of their attitudes. Regardless of theoretical framework, the present study constitutes a cross-sectional research design and, as a result, it is difficult to infer causal conclusions about the relationship between the study variables.

Conclusions and Implications

The present study explored the relationship between personality and driving behavior by investigating the role of extraversion and neuroticism in drivers' aggressive and considerate behavior toward bicyclists. The main finding was that personality plays a role in this relationship, even when personality traits were measured at the highest level of abstraction with only eight items per personality dimension. Extraversion had a direct, positive effect on aggressive behavior, while neuroticism had a direct, negative effect on considerate behavior and a direct, positive effect on aggressive behavior. The effect of neuroticism on both aggressive and considerate behavior was partially mediated by attitudes. Additionally, extraversion moderated the effect of attitudes on considerate behavior. These findings may be explained in light of the frustration-aggression model, the five-factor theory of personality, and personal maladjustment theory.

Besides implying that personality plays a significant role in drivers' behavior toward bicyclists, the finding that drivers' attitudes toward bicyclists using the road were associated with their behavior toward bicyclists implies that awareness campaigns directed at drivers' attitudes may be a serviceable approach in order to increase bicyclists' traffic safety. The finding that the effect of attitudes on considerate behavior was moderated by extraversion implies that such campaigns may be more effective on introverts than on extraverts. The negative relationship between neuroticism and attitudes implies that those high on neuroticism are the least positive toward sharing the road with bicyclists. As such, this finding implies that neurotic drivers are in most need for awareness campaigns.

Personality is only one of several factors that influence driving behavior, and the present study was able to address only a small part of the complex personality domain. In order to establish more comprehensive knowledge about the role of personality traits, future research should investigate the role of all personality dimensions in the five-factor framework, measured at different levels of abstraction. It could, as well, be serviceable to establish more knowledge about the relationship between specific personality profiles (combinations of different traits) and drivers' behavior toward bicyclists. In a traffic safety perspective, it seems imperative for future research to direct more attention to psychological mechanisms that underlie road users' proactive efforts and positive traffic behavior, as opposed to only exploring aggressive driving, risky driving and accident involvement.

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Appendix A: Invitation to participate in the study

Kjære NAF-medlem!

Du er blitt trukket ut blant våre medlemmer til å delta i en undersøkelse om samspill i trafikken. Undersøkelsen er et samarbeid mellom Norges Automobil-Forbund (NAF), Transportøkonomisk institutt (TØI) og Statens Vegvesen. Vi håper at du vil ta deg tid til å svare på våre spørsmål.

Det tar ca 10 minutter å svare på hele undersøkelsen. Hvis du svarer, er du med i trekningen av tre reisegavekort til en verdi av 5000 kroner.

Det er selvfølgelig frivillig å delta i undersøkelsen. Dette er en anonym undersøkelse og vi kommer ikke til å kople svarene du oppgir til navnet ditt.

For å svare på undersøkelsen kan du trykke på linken nedenfor. Da kommer du inn i et spørreskjema på internett, og du svarer ved å klikke deg igjennom sidene.

Link: ...<html>

Dersom du har noen spørsmål i forbindelse med undersøkelsen og utfylling av spørreskjemaet kan du sende epost til vår samarbeidspartner Aslak Fyhri på TØI: af@toi.no

Med vennlig hilsen

Norges Automobil-Forbund

Opplysningene vi samler inn vil ikke benyttes til andre formål enn denne undersøkelsen, og alle data fra spørreskjemaet blir behandlet konfidensielt. Den innsamlede informasjonen vil behandles statistisk og rapporteres i form av gjennomsnittsverdier. Ingen enkeltperson vil dermed kunne identifiseres i sluttrapporten. Undersøkelsen er meldt til Personvernombudet for forskning, Norsk samfunnsfaglig datatjeneste.

Appendix B: Questionnaire measures of personality traits, attitudes and behavior

Table B1

Questionnaire Measure of Personality Traits (Extraversion and Neuroticism)

Nedenfor finner du en rekke påstander som passer mer eller mindre godt for ulike mennesker. Vurder hvor godt påstandene passer om deg.	1	2	3	4	5	6	7
	passer ikke			passer helt			
(1) Er pratsom	1	2	3	4	5	6	7
(2) Er avslappet, takler stress godt	1	2	3	4	5	6	7
(3) Er reservert	1	2	3	4	5	6	7
(4) Er deprimert, nedstemt	1	2	3	4	5	6	7
(5) Er full av energi	1	2	3	4	5	6	7
(6) Kan være anspent	1	2	3	4	5	6	7
(7) Skaper mye entusiasme	1	2	3	4	5	6	7
(8) Bekymrer meg mye	1	2	3	4	5	6	7
(9) Har en tendens til å være stillferdig	1	2	3	4	5	6	7
(10) Er følelsesmessig stabil	1	2	3	4	5	6	7
(11) Er selvhevdende	1	2	3	4	5	6	7
(12) Kan være humørsyk	1	2	3	4	5	6	7
(13) Kan være sjenert og hemmet	1	2	3	4	5	6	7
(14) Beholder roen i spente situasjoner	1	2	3	4	5	6	7
(15) Er utadvendt og sosial	1	2	3	4	5	6	7
(16) Blir lett nervøs	1	2	3	4	5	6	7

Table B2

Questionnaire Measure of Attitudes Toward Bicyclists Using the Road

	1	2	3	4	5	6	7
	helt enig						helt uenig
Ta stilling til følgende påstander:							
(1) Jeg synes det er provoserende med syklister som tar seg til rette i trafikken	1	2	3	4	5	6	7
(2) Syklister bør kunne sykle i treningsgrupper på vanlig veg, selv om det kan hindre bilister	1	2	3	4	5	6	7
(3) Syklister er ofte et hinder for meg når jeg er ute og kjører	1	2	3	4	5	6	7
(4) De fleste syklister tar hensyn til bilister	1	2	3	4	5	6	7
(5) Syklister har like mye rett til vegen som bilister	1	2	3	4	5	6	7

Table B3

Questionnaire Measure of Aggressive Behavior Toward Bicyclists

	1	2	3	4
Har du selv gjort noe av følgende i løpet av det siste året?	Aldri	Ja, en gang	Ja, flere ganger	Ja, mange ganger
(1) Kjeftet på en syklist	1	2	3	4
(2) Tutet på en syklist	1	2	3	4
(3) Vist negative gester til en syklist	1	2	3	4
(4) Presset deg inn foran en syklist slik at denne har måttet stoppe	1	2	3	4

Table B4

Questionnaire Measure of Considerate Behavior Toward Bicyclists

Kryss av for hvor ofte du gjør følgende:	1 Alltid	2 Ofte	3 Av og til	4 Sjelden	5 Aldri
(1) Kjører forbi en syklist uten å vente for å se om det er klart	1	2	3	4	5
(2) Ligger bak syklisten, og venter med å passere til det er helt klart	1	2	3	4	5
(3) Passer på at det er minst 1,5 meters avstand til syklisten når du passerer	1	2	3	4	5
(4) Sjekker dødvinkelen for å se om det kommer en syklist når du skal svinge til høyre	1	2	3	4	5
(5) Forsøker å få øyekontakt med syklisten i kryssituasjoner	1	2	3	4	5
(6) Slipper en syklist over et gangfelt selv om han/hun ikke går av	1	2	3	4	5
(7) Slipper en syklist frem selv om han/hun har vikeplikt for deg	1	2	3	4	5
(8) Bruker blinklys når du skal svinge til høyre	1	2	3	4	5
(9) Legger deg litt til siden, slik at en syklist kan passere deg om du står i kø	1	2	3	4	5

Appendix C: Principal components analysis of the attitudes scale

The factorability of the data was assessed prior to performing principal components analysis. The correlation matrix contained several coefficients stronger than $\pm.30$ and none stronger than $\pm.90$. The Kaiser-Meyer-Olkin measure of sampling adequacy was estimated to .77, thus exceeding the recommended value of .60 (Kaiser, 1970, 1974). Furthermore, Bartlett's test of sphericity (Bartlett, 1954) reached statistical significance ($p < .001$). The correlation matrix was thus deemed appropriate for factor analysis.

Kaiser's criterion, the scree test (Catell, 1966) and parallel analysis (Horn, 1965) supported the extraction of only one component. Hence, no rotation was applied. The one-component solution explained 45.09 % of the variance.

Table C1

Factor Loadings for Principal Components Analysis of the Attitudes Scale

Item	F ₁
1	.661
2	.596
3	.758
4	.689
5	.643

Appendix D: Principal components analysis of the aggressive behavior scale

The factorability of the data was assessed prior to performing principal components analysis. The correlation matrix contained coefficients stronger than $\pm.30$ and none stronger than $\pm.90$. The Kaiser-Meyer-Olkin measure of sampling adequacy was estimated to $.72$, thus exceeding the recommended value of $.60$ (Kaiser, 1970, 1974). Furthermore, Bartlett's test of sphericity (Bartlett, 1954) reached statistical significance ($p < .001$). The correlation matrix was thus deemed appropriate for factor analysis.

Kaiser's criterion, the scree test (Catell, 1966) and parallel analysis (Horn, 1965) supported the extraction of only one component. Hence, no rotation was applied. The one-component solution explained 45.66 % of the variance.

Table D1

Factor Loadings for Principal Components Analysis of the Aggressive Behavior Scale

Item	F ₁
1	.734
2	.706
3	.763
4	.605

Appendix E: Principal components analysis of the considerate behavior scale

Both the Kaiser-Meyer-Olkin measure of sampling adequacy (Kaiser, 1970, 1974) and Bartlett's test of sphericity (Bartlett, 1954) suggested that the correlation matrix was appropriate for factor analysis (KMO = .71, Bartlett's $p < .001$).

Kaiser's criterion, the scree test (Catell, 1966) and parallel analysis (Horn, 1965) supported the extraction of three components. The three-factor solution explained 55.61 % of the variance, with the three components explaining 29.17 %, 13.66 % and 12.77 % respectively. A Oblimin rotation was applied based on the assumption that the components were correlated.

Table E1

Factor Loadings for Principal Components Analysis With Oblimin Rotation of the Considerate Behavior Scale

Item	F ₁	F ₂	F ₃
2	.796		
1	.735		
3	.467		
8	.412		
7		-.895	
6		-.884	
5			.741
9			.729
4	.356		.544

Table E2

Correlations Between the Components Underlying the Considerate Behavior Scale

	F ₁	F ₂	F ₃
F ₁	-	-.206	.243
F ₂	-.206	-	-.206
F ₃	.243	-.206	-