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Hostility, driving anger, and dangerous driving: The emerging role of hemispheric preference

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ABSTRACT

Background: Various studies have implicated psychosocial variables (e.g., hostility) in risk of dangerous driving and traffic accidents. However, whether these variables are related to more basic neurobiological factors, and whether such associations have implications for the modification of psychosocial risk factors in the context of driving, have not been examined in depth. This study examined the relationship between hemispheric preference (HP), hostility and self-reported dangerous driving, and the ability to affect driving anger via hemisphere activating cognitive exercises (HACE).
Methods: In Study 1, 254 Turkish students completed questionnaires of hostility, HP and driving behavior. In Study 2, we conducted a "proof of concept" experimental study, and tested effects of left, right and neutral HACE on driving anger, by exposing $N = 650$ Turkish students to written scenarios including either logical (left hemisphere), visuo-spatial (right hemisphere) or "mild doses" of both types of contents (control).
Results: In Study 1, left-HP was associated with higher hostility and with more dangerous driving, and hostility mediated the relationship between L-HP and reported driving behavior. In Study 2, only right-HACE led to immediate significant reductions in self-reported driving anger.
Conclusions: Left-HP is related to hostility and to dangerous driving, and it may be possible to partly reduce driving anger by right-HACE. Future studies must replicate these findings with objective measures, more enduring interventions and longer follow-ups.

1. Introduction

Traffic accidents (TA) are a complex multi-factorial public health problem, resulting from environmental, vehicle and human factors. Of the many human factors previously associated with TA, one, namely hostility, has received relatively a lot of attention. Hostility is the relative stable tendency to behave antagonistically, think cynically and feel anger across contexts (Barefoot, 1992). Hostility was found to correlate with self-reported TA and dangerous driving (e.g., Gidron et al., 2003). Furthermore, in prospective studies, hostility predicted TA and dangerous driving (e.g., Norris et al., 2000). These findings have important implications for TA, because of two reasons. First, they may serve to help identify in advance people at risk of dangerous driving and of TA, for closer monitoring and prevention. Second, though mainly based on correlation designs, these findings propose to conduct intervention trial studies aimed at reducing hostility to possibly reduce TA. Such interventions have been developed for other contexts (Cardiac patients; Gidron et al., 1999). Of greater importance, anger-management interventions have been developed and shown to be effective specifically in high-anger drivers (Deffenbacher et al., 2002).

However, though statistically significant, the effect sizes of cognitive-behavioral interventions on reducing anger or hostility are often limited (e.g., Gidron et al., 1999). It is possible that more basic neurobiological factors underlie or "drive" the relationship between hostility and dangerous driving. Such factors could not only help to explain the origin of such hostility and dangerous driving in part, but may also guide additional, and possibly more effective neuro-scientifically-based forms of intervention to prevent dangerous driving. Past studies have associated hostility with excessive right hemisphere activity (e.g., Demaree and Harrison, 1997). Behaviorally, hostility, and particularly anger expression can be divided into anger-out, the tendency towards explosive anger expression, and anger-in, the tendency to inhibit anger expression (Spielberger et al., 1985). In contrast to Demaree

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and Harrison (1997), one study found that left hemisphere activity was associated with anger-out (Hewig et al., 2004). Anger-out may be more relevant to dangerous driving since it can be manifested externally by observable behaviors including rude gestures, honking with the horn, and even aggressive acts towards drivers, all closely related to and possibly leading to dangerous driving. Such externally manifested hostility may also provoke other drivers, resulting in a possible vicious circle of hostile driving. However, it remains unknown whether left or right hemisphere functions are related to dangerous driving, and whether hostility, the broader personality construct which includes anger and aggression, plays a role in this relationship. Hemispheric preference (HP) or cerebral asymmetry reflects the relatively stable tendency to activate or use more certain functions of one hemisphere versus the other (e.g., Davidson, 2004). Recently, left-HP was indeed discussed as related to anger/hostility (Hofman, 2008). The present research examined the relationship between HP, hostility and driving anger, and dangerous driving. In Study 1, we examined the relationship between HP, hostility and self-reported dangerous driving behavior, beyond the effects of age and gender. Following the finding in Study 1 that left-HP was associated with both hostility and dangerous driving, Study 2 reflected a "proof of concept", and examined the effects of cognitive exercises aimed to minimally activate the right hemisphere in contrast to the left hemisphere, on driving anger.

2. Study 1

2.1. Method

2.1.1. Participants and procedure

The data were collected from 254 university student volunteers in Ankara, Turkey (158 males and 96 females). Two-hundred and four participants had a driving license. Only the driving license holders were included in the final analyses about hemispheric preference, hostility and aberrant driving, whereas the whole sample was used for assessing the reliability of the instruments. The participants were assured for their anonymity and confidentiality. The participants filled out questionnaires assessing aberrant driver behavior (Driver questionnaire by Reason et al., 1990), a scale assessing hemispheric preference (HP), the brief New–Buss hostility scale (Gidron et al., 2001), and demographic variables, as described below.

Among the drivers with a driving license, 68% were men, 32% were women. Participants had a mean age of 21.8 years (range 18–28 years, SD = 1.85 years). The mean lifetime mileage was 9541.75 km (range 0–300,000 km, SD = 30,334.5 km) and mean driving experience time was 2.6 years (range 0–7 years, SD = 1.5 years). The average annual mileage was 3094.6 km (range 0–100,000 km, SD = 9168.0 km).

2.1.2. Measures

2.1.2.1. Demographic measures. Respondents answered questions about their age, gender, student status, the number of years a full driving license had been held, lifetime mileage driven, and annual mileage.

2.1.2.2. Driver behavior questionnaire (DBQ). The Driver behavior questionnaire (DBQ) with extended violations was used to measure self-reported violations and errors (Reason et al., 1990). Violations were defined as "deliberate deviations from those practices believed necessary to maintain the safe operation of a potentially hazardous system." Errors can be defined as a "failure of planned actions to achieve their intended consequences that can involve the unwitting deviation of action from intention (slips and lapses) or departure of planned actions from some satisfactory path toward desired goals (mistakes)." Hence, the violations are committed deliberately but errors are done involuntarily. Moreover, violations and mistakes are potentially risky whereas slips and lapses are harmless.

The extended version of the DBQ (Lawton et al., 1997) used in this study included aggressive violations (3 items; e.g., to sound your horn to indicate your annoyance), ordinary violations (8 items; e.g., pull out of junction so far that the driver with right of way has to stop and let you pass), mistakes (8 items; e.g., misjudging the speed of another vehicle when overtaking), and lapses (8 items; e.g., forget where you left your car in a car park). Participants were asked to indicate how often they committed each of the 28 behaviors in the previous year on a six-point scale (0 = never, 5 = very often). The Turkish translation and the factor structure of the DBQ had been validated in studies conducted among both professional and non-professional drivers (see Özkan et al., 2006). In the present sample, the alpha reliabilities of the "slips and lapses", "mistakes", "ordinary violations" and "aggressive violations" were 0.86, 0.91, 0.89, and 0.75, respectively.

2.1.2.3. Hemispheric preference (HP) scale. The hemispheric preference (HP) scale (Wegner and Wells, 1985) was used to assess HP. This is a valid 12-item test, for which each item has four response options: two reflect mostly left-HP functions (verbal, logical), and two reflect mostly right-HP functions (visual, creative). The left-HP index is computed by subtracting the total number of right-HP responses from the total left-HP ones, dividing this fraction by their total, and multiplying it by 100. Thus, higher scores on the HP index reflect left-HP.

2.1.2.4. The brief New–Buss hostility scale. The brief New–Buss hostility scale (Gidron et al., 2001) was translated to Turkish and used as a measure of trait hostility. The New–Buss hostility scale includes 8 items to which participants reply by using a 5-point scale (1 = extremely uncharacteristic of me, 5 = extremely characteristic of me). The original aggression questionnaire by Buss and Perry (1992), from which the New–Buss was derived, has been translated to Turkish and used in Turkey before (see Güleç et al., 2008). Moreover, Gidron et al. (2001) reported that the New–Buss hostility scale was cross-culturally valid against multiple criteria including deviant driving, other measures of anger/hostility and atherosclerosis in men. In the present study, the internal alpha reliability coefficient of the scale was 0.75.

2.1.2.5. Statistical analysis. First, we tested correlations between all background measures and the main study variables. Second, we tested whether HP and hostility correlated with each other and with dangerous driving using Pearson correlations. Finally, we tested a mediation model, by examining whether after statistically controlling for hostility, HP still correlated with driving behavior, using analyses of covariance since HP was dichotomized at the median. The latter was done, to increase interpretability of the results, due to hypothesized differences between left and right-HP participants (Davidson, 2004).

3. Results

Groups of HP were created by splitting the HP scores at the median. No age differences were found between participants with right-HP ($M = 25.02$, SD = 9.01 years) and those with left-HP (24.62, SD = 8.73 years), $t(160) = .27$, $p > .05$. Similarly, the distribution of men and women was not significantly different between right-HP and left-HP participants ($\chi^2(1) = .23$, $p > .05$).

Table 1 depicts the means (SD) of participants on hostility and DBQ subscales, according to their HP group. As shown in Table 1,