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Psychological consequences of trauma in MVA perpetrators – Relationship between post-traumatic growth, PTSD symptoms and individual characteristics ☆

Dorota Merecz, Malgorzata Waszkowska, Agata Wezyk *

Nofer Institute of Occupational Medicine, Lodz, Poland

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ABSTRACT

The study explores two problems rarely discussed in literature. Firstly, it presents the psychological consequences of traumatic stress in perpetrators of motor vehicle accidents (MVAs). The attention of both clinicians and researchers is very seldom focused on this group of MVA participants, as in the natural way, people have a tendency to empathise with victims and distancing from those who make harm to others. MVA perpetrators usually feel no right to complain about experienced symptoms of poor well-being, and guilt prevent them against searching for any help. Such a situation may lead to further problems related to traffic safety, as persistent and untreated symptoms of PTSD or other anxiety disorders may negatively affect driving behaviour. Secondly, apart from post-traumatic psychopathology, the symptoms of post-traumatic growth (PTG) in MVA perpetrators together with factors related to them are analysed in the study. The examination results from the comprehensive sample of MVA perpetrators ($n = 236$) referred to Occupational Medicine Centres in the catchment area of Mazowieckie Voivodship, Poland, indicate that both PTSD and PTG symptoms are experienced by MVA perpetrators. The key predictors of PTG are neuroticism, conscientiousness, agreeableness and intensity of PTSD symptoms. Moreover, sex and perpetrators' injuries during the accident seem to play a vital role in the process of post-traumatic growth. Those of subjects who were women or were injured generally declared more positive changes in their life as a consequences of the accident they caused.

1. Introduction

Acute Stress Disorder (ASD), Post-Traumatic Stress Disorder (PTSD) has been examined widely as negative consequences of a traumatic experience. According to DSM-IV-R a traumatic event is the one *that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others* and to which *the person's response involved intense fear, helplessness, or horror*. There is a lot of studies on negative psychological outcomes of motor vehicles accidents (MVAs) (see e.g. Coronas, García-Parés, Viladrich, Santos, & Menchón, 2008; Lucas, 2003; Maercker, Zoellner, Menning, Rabe, & Karl, 2006), since MVAs are very common situations that have a potential of traumatising everybody involved. Usually, MVA survivors

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* Corresponding author. Address: Nofer Institute of Occupational Medicine, Department of Occupational Psychology, sw. Teresy 8, 91-348 Lodz, Poland. Tel.: +48 42 631 45 96; fax: +48 42 631 47 83.
E-mail address: awezyk@imp.lodz.pl (A. Wezyk).

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experiences fear, negative emotions, depression, anxiety and driving phobia, as well as headaches, insomnia, etc. (see Lucas, 2003 for review). MVA is claimed to be one of the leading causes of PTSD (Butler, Moffic, & Turkal, 1999; Coffey, Gudmundsdottir, Beck, Palyo, & Miller, 2006), especially in westernised countries (Hickling & Blanchard, 2007). For example, Blanchard, Hickling, Taylor, and Loos (1995) and Blanchard et al. (1996) revealed that among 158 US MVA survivors, 39.2% displayed symptoms that met the criteria for PTSD diagnosis, another 28.5% had subclinical symptoms. Researchers in UK indicated that c.a. 23% of 888 emergency attendees involved in MVA developed PTSD within 3 months from the accident and 16.3% of them still had that disorder 1 year after the event. According to Hickling and Blanchard's (2007) estimations about 25% of MVA survivors are very likely to develop PTSD after the accident.

1.1. A phenomenon of post-traumatic growth (PTG)

Within a psychopathological approach presented above (i.e. examining the negative outcomes of traumatic experiences), recovering is usually defined as alleviation of the symptoms. However, it is also known that positive changes quite often occur as a consequence of trauma. Over the last few years, a phenomenon of post-traumatic growth – PTG (known as well as benefit finding, adversarial growth or stress-related growth) – has attracted a lot of attention in psychology (see e.g. Bostock, Shiekh, & Barton, 2009; Helgeson, Reynolds, & Tomich, 2006; Linley & Joseph, 2004; Prati & Pietrantoni, 2009; Zoellner & Maercker, 2006 for reviews). The term *post-traumatic growth* was coined by Tedeschi and Calhoun (1996) to describe all the positive changes in an individual, that results from coping with adversities and stressful life events. Those situations *shatter our fundamental assumptions about ourselves and our world. In the aftermath of these extreme experiences, coping involves the arduous task of reconstruction of assumptive world, a task that requires a delicate balance between confronting and avoiding trauma-related thoughts, feelings and images* (Janoff-Bulman, 1992, cf. Janoff-Bulman, 2004, p. 30). According to Tedeschi and Calhoun's model of PTG (Tedeschi & Calhoun, 2004), a traumatic experience is a great challenge for one's: fundamental schemas, beliefs and goals, ways of coping with emotional distress and life narrative. As a result of the event, ruminations occur, that are either intrusive and automatic or more deliberate. Although continuous thinking and analysing of the traumatic experience is painful, it may lead to interesting and surprising discoveries about oneself as well as integrating new ideas into one's life schemas and beliefs. In this process people change their priorities, begin to perceive life as more valuable and appreciate many things that they have not even noticed before. They discover their resources and develop a sense of being stronger, more competent and resilient as everything seems easier and less harmful in comparison to the traumatic event. Sometimes they engage more in religion or philosophy, posing existential questions to find the meaning of what had happened to them. They also develop better, more intimate relationships with others. Tedeschi and Calhoun (1996) underline the vital role of social support in their model as supportive others aid in coping with emotional distress and finding the meaning of the event.

The theme of post-traumatic growth still needs further investigation, as there are a lot of different views on that phenomenon. Moreover, results of PTG-related research are inconsistent. Some researchers consider PTG as an outcome of coping processes (e.g. Tedeschi & Calhoun, 1996), while others question its existence and regard PTG as a kind of positive illusions, that help to manage distress (Zoellner, Rabe, Karl, & Maercker, 2008). There is also no agreement on whether and how PTG and PTSD are related. According to Tedeschi and Calhoun (2004) those two constructs are distinct and frequently coexist – the process of post-traumatic growth happens, when an individual is still distressed because of the traumatic event. Furthermore, positive changes are not equivalent to alleviation of stress symptoms. In line with this, Salsman, Segerstrom, Brechting, Carlson, and Andrykowski (2009) found that in a group of patients with cancer, PTG was not related to PTSD. Boals, Steward, and Schuettler (2010) also showed that those two phenomena are unrelated. Nevertheless, there are also studies which indicate relationship between PTG and PTSD, but the mechanism of this relationship still remains unclear. Some researchers found positive relation between PTSD and PTG (see Harms & Talbot, 2007; Kiran, Rana, & Azhar, 2010; Nishi, Matsuoka, & Kim, 2010; Pietrzak et al., 2010), others presented data showing negative correlation between these two phenomena (Hagenaars & van Minnen, 2010). There is also some evidence that the relationship between PTSD and PTG might be curvilinear with moderate level of PTSD as the best for PTG development (Kleim & Ehlers, 2009).

1.2. Factors affecting PTG

As far as factors related to PTG and its determinants are concerned, it seems obvious that a traumatic experience is fundamental for PTG development. However, Tedeschi and Calhoun (2004) point out that its not the trauma itself, but rather the process of struggling with it is crucial for PTG. Joseph (2009) also says that a traumatic experience is only a trigger for the processes (namely accommodation of individual's assumptive world to trauma-related information) that lead to positive changes. Moreover, there is also evidence for a phenomenon called vicarious post-traumatic growth (Joseph, 2009). People who did not suffer directly from trauma, but are exposed to others' suffering, e.g. family members of soldiers on service (McCormack, Hagger, & Joseph, 2011) or patients with serious illness (Kissil, Nino, Jacobs, Davey, & Tubbs, 2010; Loiselle, Devine, Reed-Knight, & Blount, 2011), counsellors and therapists (Linley & Joseph, 2007) or even people who watched the traumatic event on TV (Linley, Joseph, Cooper, Harris, & Meyer, 2003) may also experience post-traumatic growth.

Nonetheless, researchers indicate that in case of different trauma types (e.g. sexual assault, bereavement and MVA – see Shakespeare-Finch & Armstrong, 2010), people report lower or higher PTG in particular domains. These differences might be due to the extent of which traumatic event affects core beliefs about self, others and the world. Adversities that are perceived

as central to an individuals' identity are more likely to result in PTG (Boals et al., 2010; Schuettler & Boals, 2011). Trauma severity may also affect the level of PTG. Although this particular factor has not been analysed much, there are a few studies indicating that people evaluating their experience as more severe obtain higher scores in PTG questionnaires (Morris & Shakespeare-Finch, 2011; Morris, Shakespeare-Finch, Rieck, & Newbery, 2005; Tedeschi & Calhoun, 2004).

Cognitive processes are a group of variables that are important in PTG development, especially different types of rumination (intrusive and deliberate) as well as explanatory style. In Tedeschi and Calhoun's model of post-traumatic growth, ruminations are considered to play a crucial role, since they lead to analyses of the traumatic event and changes in personal schemas of the world and self. The researches confirm that assumption – frequency of ruminations after the traumatic experience is related to PTG (Calhoun, Cann, Tedeschi, & McMillan, 2000; Helgeson et al., 2006; Proffitt, Cann, Calhoun, & Tedeschi, 2007; Stockton, Hunt, & Joseph, 2011), but the relationship is different depending on the type of rumination and time since the event (Cann et al., 2011). E.g. Taku, Cann, Tedeschi, and Calhoun (2009) found that more intrusive rumination after the event and deliberate rumination in later period of time is beneficial for PTG. Cann, Calhoun, Tedeschi, and Solomon (2010) confirmed the positive relationship between recent deliberate rumination and PTG, but also revealed that recent intrusive rumination is negatively associated with PTG.

As far as the explanatory style is concerned, Ho, Chan, Yau, and Yeung (2011) found that female cancer patients who perceive the causes of good events as internal, global and stable are more likely to experience PTG. Also the ways of coping with stress are frequently examined in context of PTG (see Rajandram, Jenewein, McGrath, & Zwahlen, 2011 for review). Majority of studies indicate that active and problem-focused coping is the most beneficial for PTG development (Dirik & Karanci, 2008; Loiselle et al., 2011; Senol-Durak & Ayvasik, 2010; Sheikh, 2004; Wild & Paivio, 2003).

Social support seems to positively influence PTG (Cadell, Regehr, & Hemsworth, 2003; Dirik & Karanci, 2008; Lev-Wiesel & Amir, 2003; Love & Sabiston, 2011; Maguen, Vogt, King, King, & Litz, 2006; Pietrzak et al., 2010; Prati & Pietrantoni, 2009; Senol-Durak & Ayvasik, 2010). Probably it is the opportunity of social disclosure as well as the significant others positive reactions for the disclosure, that is vital for PTG (Taku, Tedeschi, Cann, & Calhoun, 2009).

Many of the studies on PTG aim at finding its personality determinants and modifiers. When Tedeschi and Calhoun were developing Post-Traumatic Growth Inventory (PTGI), they found that there are a lot of correlations between personality traits (measured with NEO-PI) and overall index of PTG as well as the indices of particular domains of PTG (relation to others, new possibilities, appreciation of life, personal strength and spiritual change). It turned out that extraversion, openness to experience, agreeableness and conscientiousness are positively related to PTG (total score). Furthermore, there were significant positive correlations between extraversion and all five subscales of PTGI. There were also positive relationships between openness and new possibilities; personal strength, agreeableness and relations to others as well as between personal strength and conscientiousness. Quite unexpectedly no significant correlations between neuroticism and PTG were observed (Tedeschi & Calhoun, 1996). Other research confirmed that extraversion is a predictor of PTG (Sheikh, 2004; Val & Linley, 2006). There is a lot of studies on relationships between PTG and optimism, but the results are quite contradictory (see Bostock et al., 2009 for review). Some evidence is available, that the higher the individual's resilience, the more probably PTG occurs (Chan, Lai, & Wong, 2006; Nishi et al., 2010). On the other hand, researchers point out that if a person is very resilient, the traumatic event may not be perceived as challenging for her self or world view (Levine, Laufer, Stein, Hamama-Raz, & Solomon, 2009; Tedeschi & Calhoun, 2004). Post-traumatic growth also seems to be positively related to spirituality (Cadell et al., 2003; Prati & Pietrantoni, 2009; Smith, Dalen, Bernard, & Baumgartner, 2008).

Studies on post-traumatic growth were carried out mainly in relation to such traumatic experiences as: cancer, bereavement, military service and terrorism. Research on PTG in MVA survivors is scarce. However, theory and existing pieces of research entitle to expect that MVA survivors might develop PTG (see e.g. Harms & Talbot, 2007). Heretofore, studies on this theme indicated that MVA survivors get higher score in PTGI than sexual assault victims, but not as high as people who have lost a close relative (Shakespeare-Finch & Armstrong, 2010).

In MVA survivors group, PTG was proved to be related positively with both sense of coherence and PTSD symptoms and these relationships were specific for particular domains of PTG. Relating to others, new possibilities and personal strength were associated with sense of coherence, while appreciation of life and spiritual change were related to PTSD (Nishi et al., 2010). In another study gender differences in relationships between PTG domains and PTSD symptoms were found. In male group new possibilities and appreciation of life were positively related to intrusions, while in females – new possibilities correlated positively with avoidance (Harms & Talbot, 2007). There was also a study on neurological fundaments of PTG in MVA survivors. It turned out that relative left baseline prefrontal activity was positively related with self-assessed PTG level. Furthermore, the relationship was found between relative left fronto-central activity and changes in all the domains of PTG, but for spiritual change (Rabe, Zoellner, Maercker, & Karl, 2006).

According to our best knowledge, there were no research on core personality dimensions (i.e. Big Five) in relation to PTG after MVA. What is more, the group of MVA perpetrators is not in a scope of interest both clinicians and researchers. There are few communications about mental health of drivers who caused MVA after alcohol consumption but they are rather anecdotical (see e.g. Valent, 2007, 2011). Thus the aim of our research was to find out what are the MVA consequences i.e. PTSD and PTG in the perpetrators and whether there is any kind of relationship between those two phenomena. We conducted a cross-sectional exploratory study to determine any possible relationships between personality factors and PTSD symptoms and PTG in drivers – perpetrators MVA. Since there is little information on post-traumatic growth and PTSD development in case of such a traumatic experience as causing life-threatening MVA, we asked general questions: (1) Are there any positive consequences (in terms of PTG) of MVA on its perpetrators? (2) Are PTSD symptomathology and post-traumatic

growth separate, mutually exclusive phenomena, or there is some link between them? (3) Do the MVA perpetrators with higher PTG differ from those with lower PTG in terms of personality, PTSD symptoms and accident severity?

2. Material and methods

2.1. Procedure

The study was conducted in 2008. Participants were recruited from the group of drivers (MVA causers) that were obliged to put themselves under psychological examination in one of three Occupational Medicine Centres (OMCs) in Mazowieckie Voivodship/district. We had chosen this particular group of accident participants, since they are rarely taken care of after MVA, though it is very likely that their mental health is severely affected by the incident. A motor vehicle accident is defined in Poland as the event on the road resulted in injuries or deaths of its participants/participant, the subjects under the study were only drivers who caused road traffic injuries/fatalities. There were two exclusion criteria: (1) being intoxicated at the scene of accident (alcohol, drugs) and (2) period of time between MVA and attending the examination was shorter than a month. Each participant was informed about the aim of the study and that the results of the study did not affect any medical or psychological certificate they got in OMC procedure. Participation in the study was voluntary and anonymous. After giving his/her written consent participant filled in a set of questionnaires.

2.2. Participants

Two-hundred and thirty-six sets of questionnaires were administered and all were re-collected, but only 205 of them were included in a statistical analysis, since there were key data missing in the remaining 31 sets. The participants' age ranged from 19 to 93 with the mean value at 37. In that group there were 39 women (19%) and 166 men (81%). Majority of them (47%) had secondary education, 20.5% – basic vocational education, 16.1% – higher education, 9.8% – primary education (the values does not sum up to 100% since about 10% of participants did not answer that particular question).

2.3. Measures

To assess personality variables NEO-FFI Inventory (Costa & McCrae, 1992; Zawadzki, Strelau, Szczepaniak, & Śliwińska, 1998) was used. It is a well-known questionnaire that allow to measure five characteristics: extraversion, neuroticism, openness to experience, agreeableness and conscientiousness. The reliability and validity indices of Polish version of NEO-FFI are satisfactory. 60 items (12 per each subscale) describing one's traits are assessed on 5-points Likert scale. NEO-FFI Inventory has Polish norms adjusted for age based on sten scale. Low scores ranges from 1st to 4th sten, average scores (5th–6th sten) and high scores (7th–10th sten).

Post-traumatic growth was measured with a Polish questionnaire "Life Experience Enrichment" (LEE) developed by Kaniasty (2003). It contains 22 questions based on items from two questionnaires: Stress Related Growth Scale (Park, Cohen, & Murch, 1996) and Post-Traumatic Growth Inventory (Tedeschi & Calhoun, 1996). We had chosen that particular measure, since at the time of the study it was the only PTG questionnaire available in Polish version. Respondents assess the degree of positive changes after a traumatic experience on 4-point Likert scale ranging from 1 – *there was no such change* to 4 – *such a change was great*. There are two subscales in this questionnaire: Personal Experience Enrichment and Changes in Social Functioning. An example item is: *As a result of (traumatic experience) I have learned to be more persistent in solving problems and not to give up so quickly*. According to the Author, the whole questionnaire is highly reliable (Cronbach alpha = .94), as well as its subscales (Cronbach alphas are .905 and .92 respectively for Personal Experience Enrichment and Changes in Social Functioning).

PTSD-Interview (Watson, Juba, Manifold, Kucala, & Anderson, 1991) in Polish adaptation by Koniarek, Dudek, and Szymczak (2000) was applied to assess PTSD and its subclinical symptoms. The original form of PTSD-I was modified and in Polish version (PTSD-K) it has a form of a self-description questionnaire. Full version includes three parts:

(a) self-description of a traumatic experience,
(b) items related to frequency and intensity of PTSD symptoms based upon the DSM-IV diagnostic criteria (trauma re-experiencing, avoidance and hyperarousal – three subscales of five, seven and five items respectively, assessed on 7-point Likert scale ranging from 1 – never/no at all to 7 – always/very strong) and
(c) two questions about the period of symptoms lasting.

Reliability and validity of Polish version of PTSD-I have been verified (Koniarek et al., 2000). The Authors had reported that the Cronbach's alphas were as following: .90 for PTSD-K, .78 for Re-experiencing subscale, .74 for Avoidance subscale, and .87 for Hyperarousal subscale. Validity was confirmed by comparing the questionnaire results obtained by 12 patients with the expert (psychiatric) diagnosis. The level of rater agreement was 100%. In this study only the second and third part of the questionnaire was applied. The subjects were instructed to answer the questions keeping in mind the MVA they recently participated in.

2.4. Statistical methods

To examine the possible relationships between the chosen variables we run a set of statistical analyses using the software of SPSS Statistics 12.0. To determine whether demographical factors, accident characteristics, personality and PTSD symptoms are associated with PTG in MVA perpetrators a series of univariate analyses of variance (ANOVA) was performed. In the course of statistical analyses two groups were constituted: with low level of PTG (lowPTG – LEE results ranging from minimum to Mean − 1 SD) and high level of PTG (highPTG – LEE results ranging from Mean + 1 SD to maximum). We decided to use the statistical indicators (Mean and SD), since LEE norms do not exist.

We also applied multiple regression analyses to check, whether socio-demographic characteristics (i.e. sex, age, level of education), accident attributes (number of accident and its severity, i.e. number of injured people and casualties), personality traits and intensity of PTSD symptoms may serve as predictors of PTG in MVA perpetrators. Three models – one for overall PTG result, and one for each PTG dimension (i.e. personal enrichment and social functioning) were tested. The variables were always introduced into the models in the same order, i.e. socio-demographic characteristics, then PTSD variables and finally personality traits. No variables were forced in the models.

3. Results

About 70% of the participants had the accident within 2–24 months before the study, the rest – more than 2 years before. For 87.3% respondents it was the first time in their life that they caused an accident. 16.6% of the participants were injured in this accident. In case of 53.7% of analysed accidents – 1 person (other than the perpetrator) was injured, in 13.2% cases – 2 or more people were injured. One person was killed in 36.6% of the accidents, 2 and more – in 1% of the accidents. Based on the results of PTSD-I, it was found that 11% of study participants met DSM-IV criteria for PTSD.

In Table 1 descriptive statistics of chosen variables are presented.

Differences in personality traits (extraversion, neuroticism, openness to experience, agreeableness and conscientiousness), PTSD symptoms (re-experiencing, avoidance and hyperarousal), accident characteristic (number of accidents, number or people injured and killed, driver injured or not) and demographical characteristics (age, sex, education) between those two groups were assessed (see Table 2 for ANOVA results).

Statistical analyses revealed significant differences between lowPTG and highPTG groups in five aspects. Within the personality factors only neuroticism differentiated both groups and highPTG group scored higher in the NEO-FFI subscale Neuroticism. Significant differences between both groups were observed also in three kinds of PTSD symptoms as well as the overall result in PTSD-I. Again, highPTG group got higher scores in this questionnaire.

Since it is possible in LEE questionnaire to assess changes in two domains: personal experience (PTG-PE) and social functioning (PTG-SF), the differences within groups with high and low PTG-PE level as well as high and low PTG-SF level were examined (see Table 2 for ANOVA results). The groups were constituted in the same way as in case of groups with overall low and high LEE results.

There were significant differences in neuroticism between both low/highPTG-PE groups and low/highPTG-SF groups. HighPTG-PE group got higher results in Neuroticism subscale in comparison to lowPTG-PE. Similar results were observed in case of lowPTG-SF and highPTG-SF groups. Furthermore, agreeableness differentiated lowPTG-SF and highPTG-SF groups.

Analyses revealed also significant differences in PTSD symptoms and overall index between both low/highPTG-PE and low/highPTG-SF groups. Respondents with highPTG-PE reported higher level of PTSD symptoms (see picture 6 and 7). Similar results were obtained in case of low/highPTG-SF groups.

Age and sex differences were also observed in case of examined groups. It turned out, that lowPTG-SF group tended to be older (M_1 = 39.38 in comparison to M_2 = 33.61 in highPTG-SF, F = 3.453 p = 0.067) and in highPTG-PE group there were more women than in lowPTG-PE group (42.9% and 17.1% respectively). Only one accident characteristic differentiated both low/highPTG-PE and low/highPTG-SF groups. More perpetrators were injured in the accident both, in highPTG-PE (32.5% in comparison to 12.5% in lowPTG-PE group) and highPTG-SF groups (28.6% in comparison to 7.7% in lowSF group).

Table 1
Mean scores of examined variables.

Variable	Mean	SD	Minimum	Maximum
PTSD	34.71	17.299	13	116
Re-experiencing	10.30	5.315	5	33
Avoidance	15.05	8.072	3	48
Hyperarousal	9.36	5.557	5	35
PTG (overall)	41.83	17.675	7	85
Neuroticism	3.93	1.864	1	10
Extraversion	6.54	1.724	2	10
Openness to experience	5.02	1.840	1	10
Agreeableness	7.10	1.744	2	10
Conscientiousness	7.37	1.666	3	10

Table 2
Significant differences between groups with low and high level of PTG, PTG-PE and PTG-SF.

Variable	PTG factor		Univariate *F*	*p*
	Low	High		
PTG –total score				
PTSD (overall)	23.39	43.48	29.031	0.000
Re-experiencing	7.39	12.74	19.210	0.000
Avoidance	9.55	19.36	33.441	0.000
Hyperarousal	6.45	11.38	16.164	0.000
Neuroticism	3.32	4.36	4.747	0.033
Personal enrichment subscale				
PTSD (overall)	23.08	43.23	37.573	0.000
Re-experiencing	7.18	12.60	25.263	0.000
Avoidance	9.48	19.48	45.376	0.000
Hyperarousal	6.43	11.15	17.834	0.000
Neuroticism	3.28	4.43	7.125	0.009
Social functioning subscale				
PTSD (overall)	27.16	44.00	16.660	0.000
Re-experiencing	8.66	12.71	9.717	0.003
Avoidance	10.92	19.81	23.728	0.000
Hyperarousal	7.58	11.48	8.521	0.005
Neuroticism	3.38	4.38	5.132	0.026
Agreeableness	6.95	7.75	4.370	0.040
Conscientiousness	7.13	7.93	4.294	0.042

Table 3
Multiple regression predicting PTG level (overall LEE result).

Multiple regression models[a]		R^2	Beta	*F*	*p*
Post-traumatic growth (PTG)					
1	PTSD-I (overall result)	0.076	0.310	15.275	<0.001
2	Conscientiousness	0.097	0.162	10.264	<0.001
Personal Experience Enrichment (PTG-PE)					
1	PTSD-I (overall result)	0.067	0.218	13.338	<0.001
2	Conscientiousness	0.091	0.218	9.627	<0.001
3	Neuroticism	0.107	0.178	7.944	<0.001
4	Sex (*M* vs. *F*)	0.128	0.162	7.354	<0.001
Changes in social functioning (PTG-SF)					
1	PTSD-I (overall result)	0.09876	0.347	19.900	<0.001
2	Conscientiousness	0.119	0.162	12.717	<0.001

[a] Because of the number of variables examined, only results of significance were displayed in a tabular format.

In the multiple regression analysis intensity of PTSD symptoms (overall result of PTSD-I) and conscientiousness (measured with NEO-FFI) were indicated to be predictors of PTG and explained 9.7% of variance in LEE scores (see Table 3).

Similar results were obtained for PTG-SF. Almost 12% of PTG-SF variance were due to two above-mentioned variables (i.e. PTSD and conscientiousness), while PTG-PE was predicted by PTSD level, conscientiousness, neuroticism and sex. This model explained 12.8% of PTG-PE variance.

4. Discussion

The results of the study confirm that people who caused road traffic injuries may experience wide spectrum of PTSD symptoms. Moreover it was demonstrated that perpetration of MVA did not preclude appearance of post-traumatic growth symptoms.

The results suggest that PTG development might be dependent on the psychological and socio-demographic profile of MVA perpetrators as well as on the characteristics of the traumatic event (in this case MVA). These findings are at least partly consistent with the existing literature on the PTG theme.

Women reported significantly higher level of changes in personal experience. Tedeschi and Calhoun (1996) also observed sex differences in PTG development (though in their study the greatest difference regarded the aspects of interpersonal relations and spiritual changes). It might be that men and women react differently for traumatic experience and that women are more likely to benefit from trauma. It is also probable that since women are more self-aware, they perceive more changes in their life and are able to report them in a more detailed way during the examination.

Age differences were also noticed in the current study. Though age did not appear to be a significant predictor in the regression model for PTG, the ANOVA test showed that, the group with greater changes in social functioning tended to be younger. There are at least two possible explanation of this result. First, young people are usually more self-oriented than older ones and traumatic event may change this attitude. If it is true, the self-perceived difference in approach to others after trauma should have been bigger in younger than older people. Secondly, it is well known that openness to experience declines over time that indicates less interest in forming new relationships, and sticking to a small group of proven friends and relatives (Srivastava, John, Gosling, & Potter, 2003) Older people are also more agreeable, conscientious and emotionally stable than younger ones are (Roberts & Mroczek, 2008), so probably positive changes in the sphere of social functioning after trauma among older adults will be less evident. Age loss of significance as a variable explaining variation of PTG scores in the regression models might be related to the fact that NEO-FFI trait scores based on Polish population norms (also included into models) are adjusted for age.

It is worth to notice that MVA perpetrators with higher PTG (overall as well as in case of both examined PTG aspects) demonstrated higher PTSD level (in all three PTSD symptoms). There is no agreement on the theme of PTG–PTSD relationships, but in a few studies a positive linear association was revealed (Harms & Talbot, 2007; Nishi et al., 2010; Pietrzak et al., 2010). It is acknowledged that the traumatic experience is essential to develop PTG (Tedeschi & Calhoun, 1996, 2004). It might be that when the event produces more severe post-traumatic stress symptoms, it makes PTG more probable to appear. There is another result in this study that is consistent with this explanation. The ANOVA test showed that – both in case of positive changes in personal experience and social functioning – in the groups with higher PTG more perpetrators were injured. Being injured is quite likely to result in perceiving the event as more traumatic. It is quite reasonable to think that post-traumatic growth is possible only when suffering induces the deep reflection over one's life and forces people to ask themselves about the sense of their own existence. Ruminations which are one of the core PTSD symptoms seem to facilitate the after-thought process and give a chance for positive self-development (Tedeschi & Calhoun, 2004). It is quite interesting, however, why the objective variables reflecting the severity of an accident (number of injuries and fatalities) did not reach the level of significance in the regression model for PTG. The pattern of obtained results may indicate that not objectively assessed severity of event but rather individual reaction to it and personal traits are crucial for PTG. Surely, this problem needs further research.

Quite unexpectedly the perpetrators with higher level of PTG (in both aspects, i.e. Personal Experiences and Social Functioning) scored higher on Neuroticism scale of NEO-FFI. Already published studies on relationship between PTG and neuroticism brings mixed results. In most of the former research no correlations between those two variables were found (Helgeson et al., 2006; Jaarsma, Pool, Sanderman, & Ranchor, 2006; Tedeschi & Calhoun, 1996, 2004). In some studies however, the significant negative relationship between neuroticism and PTG was found (Evers et al., 2001; Garnefski, Kraaij, Schroevers, & Somsen, 2008). One might expect, that neurotic people are less likely to develop PTG, because of their negative affectivity and lower ability to manage stress (Costa & McCrae, 1992). It was also indicated that pattern of cerebral activity is similar for PTG and dispositional positive affect (Rabe et al., 2006). According to our knowledge, no pervious study has reported positive association between neuroticism and PTG. However, it needs to be noticed that in the current study, mean value of Neuroticism in both groups was rather low. In case of drivers with higher PTG, it has only reached the average level and that is not enough to assume that those people were emotionally unstable or had particular problems with coping with stress. In the light of obtained results, one may come to the conclusion that an average level of neuroticism sensitises persons to life events but has no significant effect on the effectiveness of coping with them. In other words, they are more likely to perceive an event as extremely stressful or traumatic, what is essential for post-traumatic growth, but at the same time they have enough personal resources to cope with the pain of trauma. Such a way of thinking leads to the suggestion that relationship between neuroticism and PTG might be curvilinear but further studies are necessary to confirm this hypothesis.

It is much easier to explain the group differences in agreeableness. It was found that people with greater positive changes in social functioning got higher scores on NEO-FFI Agreeableness scale. This particular result were observed in Tedeschi and Calhoun's (1996) study too. It is not astonishing, since agreeable people are more friendly, and convinced about others' good intentions (Costa & McCrae, 1992). This may result in larger network of support and better social contacts as well as perceiving others as more supportive (John & Srivastava, 1999; Wehrli, 2008). People with high Agreeableness are also helpful and people-oriented (John & Srivastava, 1999). It is quite interesting, though, that in the regression model Agreeableness was not a significant predictor of variance of PTG score. The reason for that might be that Agreeableness and Conscientiousness assessed with Polish version of NEO-FFI correlates with each other (Zawadzki et al., 1998). It must be noticed that the latter trait (conscientiousness) was not only found to differentiate drivers with low and high level of changes in social functioning, but it was the only personality trait that was a predictor for PTG and its two aspects. This result is in line with Hobfol's et al. (2007) explanation, that cognitive processes in re-adaptation after a traumatic experience are not enough to develop PTG. For a change to take place an individual must engage himself in action. Conscientious people are more persistent and meticulous in achieving their goals as well as more disciplined (Costa & McCrae, 1992) and that might be helpful in PTG development (Tedeschi & Calhoun, 1996). Yet, there is no agreement on the role of consciousness in post-traumatic growth in the literature. For example Shakespeare-Finch (2005), and Garnefski et al. (2008) found this trait as a important predictor of PTG while in the study of Wilson and Boden (2008) conscientiousness did not predict the growth.

As one could notice, within the studied group the mean level of Agreeableness as well as Conscientiousness was elevated and reached the 7th sten according to Polish norms adjusted for age. The reason for this may be rooted in psychological situation of perpetrators during the examination. Two above-mentioned traits are perceived as positive and socially desirable.

The subjects were referred to the diagnostic centre by police after being reported as the accident causers. Thus, it is quite likely that they wanted to present themselves in the best possible way what was reflected by social desirability bias (Krahe, Becker, & Zollter, 2008; Sandal, Musson, Helmeich, & Grandal, 2005).

5. Conclusion and limitations

Considering the results presented in this paper it is necessary to keep in mind the limitations of the study. The first limitation concerns the cross-sectional and retrospective nature of this research project. Cross-sectional study design does not entitle for formulation of cause–effect conclusions. This is rather the exploration of possible relationships between variables under the study based on empirical evidences and theory presented in literature. Another disadvantage of the study is the fact that subjects differed significantly in terms of the time passage between motor vehicle accidents and psychological examination – some of them were examined couple of months after trauma other a year or more after the event. Such a situation might have affected the quality of collected data as it is known that both symptoms of PTSD and PTG vary across time. It also imposed the challenge to the subjects of recollecting events, emotional states, thoughts and behaviours which took place long time ago. Some studies on memory of traumatic events suggest the essence of a traumatic event might be relatively well retained in memory, while memory is impaired for many of the specific, and especially peripheral, details (Christianson & Loftus, 2006). Moreover, a lot of inconsistencies was found in reporting traumatic events (Hepp et al., 2006). These studies suggest that time when the examination is done may influence the results obtained with a help of self-administered measures.

Despite of aforementioned limitations of the study, it is worth to underline that it is one of quite rare research projects exploring psychological consequences of trauma among causers of motor vehicle accidents. As one can observe, MVA perpetrators – just like MVA victims – experience wide spectrum of PTSD and PTG symptoms. The results of analyses conducted in the study support the conviction that post-traumatic stress symptoms and PTG are interrelated, however distinct phenomena. Moreover, the process of post-traumatic growth seems to be facilitated by some personality characteristics and severity of consequences which trauma brought about. The afore presented results regarding factors related post-traumatic growth should be verified in prospective studies.

Although the study was aimed at exploration of psychological outcomes after MVA in perpetrators, it also has some clinical implication. We found that around 11% of MVA perpetrators develops PTSD which may decrease their driving ability put them at risk of further motor vehicle collision and accidents (Lucas, 2003; Mayou, Bryant, & Ehlers, 2001). In the light of this result, it seems important to provide assessment of driving ability after MVA which include the diagnosis of mental health (especially anxiety disorders) and training aimed at improving of driving skills affected by trauma and desensitisation to trigger factors. Thanks to development of technology the positive effects can be obtained relatively easily with the help of virtual reality tools. From the perspective of safety on roads, the psychological status of MVA perpetrators should not be left unattended. It is also worth to consider the possibility of strengthening development of constructive side of PTG in MVA perpetrators by means of psychotherapy or counselling as it may be beneficial for drivers' performance and stimulate safe and responsible driving behaviours. Since now little is known about the relationship between PTG and drivers' functioning, although preliminary unpublished results of study performed by authors shows the positive correlation between PTG and driving style. Further prospective studies are needed to explore relationship between PTSD, PTG and driving behaviours in survivors of motor vehicle accidents.

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