

Aspects of cognitive anxiety and occurrence of accidents among firefighters

Dorota E. Ortenburger , Jacek Wąsik , Anatolii Tsos 

Jan Dlugosz University, Czestochowa, Poland

Medical Studies 2026; 42 (2): 208–213

DOI: <https://doi.org/10.5114/ms.2026.162678>

Key words: anxiety, stress, STAI, firefighter.

Abstract

Introduction: People with a high level of anxiety traits are observed to have the tendency to have more intensive emotional reactions that are frequently disproportional with relation to the actual level of risk.

Aim of the research: The aim of research is to expand knowledge on the subject of the relationship between anxiety trait and the effectiveness of activities in a context that is specific for the work of firefighters.

Material and methods: The research encompassed 112 people on duty in the fire services, including 90 men (aged: 32.23 ± 7.38 yrs; work experience 9.73 ± 6.28 yrs) and 22 women (aged: 28.13 ± 2.53 yrs, work experience 5.22 ± 4.01 yrs) serving in the State Fire Services. The measurement was conducted with the aid of a standardised questionnaire named the State-Traits Anxiety Inventory (STAI). With the aim of estimating the difficulty with maintaining focus, a scale was applied that is compatible with this problem in the Amen Clinic Abbreviated Brain System Questionnaire.

Results and conclusions: Such factors as years of activity in the fire services and the number of accidents explain 40.5% of the variability of the intensity of anxiety as a disposition (trait anxiety). After taking account of the cognitive factor in the regression model in the form of difficulty with focus, the percentage of the clarified variance increased the trait level to 66%. The conducted analysis facilitated the identification of three differentiated clusters of firefighters ($p < 0.001$) from the viewpoint of trait anxiety, as well as difficulty with maintaining cognitive focus and the number of accidents.

Introduction

In psychological literature, greater attention is paid to personality traits that have an impact on the ability of the individual to cope in difficult situations that are a threat to health or life [1, 2]. One of the key notions in this sphere is the so-called “trait anxiety”, which is perceived as the relatively constant internal disposition that reflects the individual differences in the susceptibility to feeling anxiety [3]. Trait anxiety as a theoretical construct refers to the behavioural tendencies of an individual to perceive the broad scope of situations, even those that are objectively neutral or that pose little danger, as stressful or dangerous. People with a high level of anxiety traits are observed to have the tendency to have more intensive emotional reactions that are frequently disproportional with relation to the actual level of risk [4].

A significant element of this construct is the cognitive aspect, or in other words, the way in which the individual perceives, interprets, and evaluates a particular situation. Research indicates that people with a high intensity of anxiety traits are more exposed to an increase in the state of anxiety when faced with danger. In such cases, anxiety traits may act as a factor that strengthens the subjective perception of danger,

which in turn translates into difficulty with adapting to the new or stressful conditions [5].

The hitherto correlational study also indicates that people with a high level of anxiety traits are featured by a limited ability to take action effectively in situations that require great mental or physical effort, particularly when faced with dynamically changing circumstances. The reduced mental stamina and the tendency to be easily distracted mean that people have difficulty with regulating emotion, a lower level of activity, and a lower level of efficiency in terms of taking action in crisis situations [6].

With regard to the specifics of their work, firefighters are exposed to a high level of stress, as well as the risk of the occurrence of anxiety attacks. Research conducted on a group of 248 firefighters in Northern Ireland [7] illustrated that a higher level of mental suffering was associated with a more frequent experience of negative emotions connected with incidents, the external feeling of control, a lower level of using strategies of coping concentrated on tasks and emotions, and the frequent application of the strategy of avoidance. It was additionally claimed that more frequent exposure to stressors associated with incidents weakened the dependency between placing the feeling of control and mental suffering, while

also between the avoidance of coping and mental stress. The strategy of avoidance turned out to be the main factor that has an impact on the clarification of the variance at the level of mental suffering.

The consequences of chronic stress in this professional group may be various somatic and mental symptoms, such as accelerated breathing, and increased pulse and blood pressure [8], as well as petulance, irritation, and problems with concentration. Long-term exposure to stress may lead to more serious disorders, such as post-traumatic stress disorder (PTSD) [9, 10]. Research illustrates that firefighters with longer work experience are more susceptible to the development of symptoms of PTSD in comparison to people with shorter work experience [11, 12]. With the aim of minimising the negative effects of stress and anxiety amongst firefighters, it is important to implement the programs of psychological support, while also training in the area of coping with stress. Enhancement of the working conditions, including the increased control of the tasks executed, as well as streamlining internal communication, may significantly lead to the reduction of the level of stress in this professional group.

Based on these premises, research questions were formulated aimed at expanding knowledge on the subject of the relationship between anxiety and traits, while also the efficiency of activities in a context that is specific for firefighters:

Material and methods

Participants

The research encompassed 112 people in the fire services, including 90 men (aged: 32.23 ± 7.38 yrs; work experience 9.73 ± 6.28 yrs) and 22 women (aged: 28.13 ± 2.53 yrs, work experience 5.22 ± 4.01 yrs) conducting service in the State Fire Services (SFS) in the province of Silesia (Poland).

Research tools

The measurement was conducted with the aid of a standardised questionnaire named the State Traits Anxiety Inventory (STAI), originally termed the Self-Evaluation Questionnaire, which is recommended for the diagnosis of the predisposition to carry out professions that require a higher level of resistance to stress and risk, including, e.g. firefighters, soldiers, and security guards. In normalised research, the co-factors of internal compliance were estimated in terms of Cronbach's α in the case of the results for soldiers. The findings turned out to be high (Cronbach's α for the results of soldiers on duty with less experience was 0.93, and 0.90 for soldiers on duty with more experience). The applied research survey of the anxiety disposition and traits consists of 20 questions, for which it is possible to receive between 20 and 80 points.

The person under analysis has the task of indicating the digits on a scale from 1 to 4, which describes his/her subjective feeling most precisely. The higher the test result, the higher the level of anxiety as a disposition [13]. The construction of the scale of anxiety trait respects individual differences in the tendency to understand the world [14]. With the aim of estimating the difficulty with maintaining focus, a scale was applied to be compatible with this problem as stipulated in the Amen Clinic Abbreviated Brain System Questionnaire [15].

Ethical approval

The research presented is of a voluntary nature and was preceded by receiving prior consent. All the participants of the analysis were informed of the procedures and voluntarily participated in the collection of data. The research was conducted in accordance with the principles of ethics on the basis of the Declaration of Helsinki.

Statistical analysis

The sample size was estimated with the use of the G*Power software (3.1.9.2 version; University of Kilonia, Kilonia, Germany) [16], which returned a minimum of 81 participants, for $\alpha = 0.05$, magnitude of effect $f^2 = 0.2$ and $\beta = 0.95$. All the defined indicators were calculated as an average value and standard deviation (SD). The co-dependency of the variables was checked by the analysis of multifaceted regression. With the aim of conducting taxonomy of the analysed persons on the basis of the data acquired, analysis was conducted on the k-Means, which is a method recommended for statistical analysis of this type of material. To find out if the data is similar or different, the K-Means algorithm uses the distance between the data [17]. Observations that are similar will have a smaller distance between them. The statistical significance was accepted at the level of $p < 0.05$. All calculations were conducted with the aid of Statistica 12.00 software.

Results

The research results on the basis of the model of regression analysed, which is presented in Table 1, illustrates that the 2 factors such as years of work experience in the fire services and the number of accidents explain 40.5% of the variability of the intensity of anxiety as a disposition, and the adjusted $R^2 = 0.394$ takes account of the number of predictors in the model. The multiple correlation coefficient $R = 0.636$ indicates the moderately strong relationship between the analysed predictors and the level of trait anxiety. The model presented is statistically significant $F(2,109) = 37.132, p < 0.001$. After taking account of one more factor, in the form of difficulty with focus, in the model of regression, the percentage of clarified variances

Table 1. Level of anxiety as disposition (trait anxiety) Model 1: $R = 0.636$; $R^2 = 0.405$; Adjusted. $R^2 = 0.394$; $F(2.109) = 37.132$; $p < 0.001$ Error of standard estimation: 10.255. Model 2: $R = 0.816$; $R^2 = 0.666$; Adjusted $R^2 = 0.065$; $F(3.108) = 72.048$; $p < 0.001$; Error of standard estimation: 7.711

Model	Predictor	Beta	ES	B	ES	$t(109)$	P-value
1	Seniority-years of activity	0.276	0.079	0.591	0.169	3.507	0.001
	Work accidents	0.485	0.079	5.797	0.941	6.160	< 0.001
2	Seniority-years of activity	0.181	0.060	0.388	0.129	3.012	0.003
	Difficulty with maintaining focus	0.579	0.063	0.724	0.079	9.208	< 0.001
	Work accidents	0.262	0.064	3.126	0.765	4.088	< 0.001

ES – error of standard estimation.

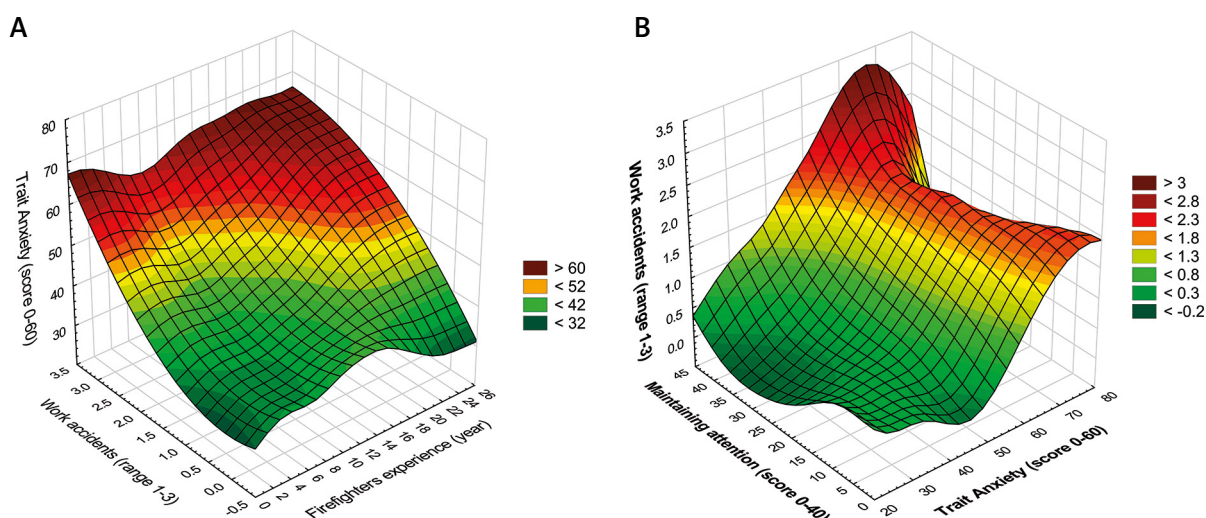


Figure 1. Graphic interpretation of dependencies of three predictors. **A** – anxiety as disposition (state anxiety) and years of activity in fire services and number of accidents (on a scale of 1-3). **B** – Anxiety as disposition (state anxiety) and difficulty in maintaining focus (on a scale of 0–40) and the number of accidents

of the level of anxiety disposition increased to 66%. $R = 0.816$, $R^2 = 0.066$, adjusted $R^2 = 0.657$, $F(3.108) = 72.048$, $p < 0.001$, error of standard deviation: 7.711.

The calculated size of the particular standardised coefficients (Beta) and non-standardised coefficients (B) of regression (focus) indicates that such factors as difficulty with maintaining focus, accidents, and years of activity in executing tasks in the fire services are elements that can play a significant role in feeling trait anxiety, together with psycho-physical consequences. This is one of a multitude of reasons that confirm that activities aimed at improving work safety may lead to the reduction of the level of anxiety amongst firefighters and enhance the level of functioning in situations of danger.

Figure 1 presents graphic illustrations of the relationship between the intensity of anxiety as a disposition (trait anxiety) and the number of years of activity in the fire services, the number of accidents in this period, and the relationship between trait anxiety and

the difficulty with maintaining focus and the number of accidents.

Analysis conducted on the data relating to the level of dispositional anxiety, the years of professional service, difficulty with focus, and the number of accidents at work facilitated the identification of three differentiated clusters of firefighters (Table 2). Cluster 1 ($n = 30$; years of activity 6.83 ± 4.27 ; difficulty with maintaining focus: 27.00 ± 6.57 ; number of accidents at work: 0.46 ± 0.77 ; dispositional anxiety: 41.30 ± 5.93), is a group characterised by a relatively low level of years of activity and moderate level of dispositional anxiety. The indicators of the maintenance of focus and the number of accidents at work are also at a moderate level. Cluster 2 ($n = 37$; years of activity: 12.78 ± 6.73 ; difficulty with maintaining focus: 32.43 ± 5.24 ; number of accidents at work: $M = 1.78 \pm 1.21$; dispositional anxiety: $M = 56.70 \pm 6.61$) is a group that is distinguished by the highest level of dispositional anxiety and the greatest intensity of difficulty with maintaining focus and

Table 2. Three clusters of results revealed relating to firemen differentiated from the viewpoint of the intensity of anxiety as disposition, as well as years of activity and difficulty with maintaining focus and accidents in this period

Indicator	Cluster 1		Cluster 2		Cluster 3		<i>F</i>	<i>P</i> -value
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Years of activity in fire services	6.83	4.27	12.78	6.73	6.95	5.21	13.91	< 0.001
Difficulty with maintaining focus	27.00	6.57	32.43	5.24	11.86	4.09	170.81	< 0.001
Accidents at work	0.46	0.77	1.78	1.21	0.31	0.59	31.74	< 0.001
Anxiety as disposition	41.30	5.93	56.70	6.61	28.62	3.89	267.45	< 0.001

M – mean, *SD* – standard deviation.

number of accidents at work. firefighters in this group have the longest work experience. Cluster 3 ($n = 45$; years of activity: 6.95 ± 5.21 ; difficulty with maintaining focus: 11.86 ± 4.09 ; number of accidents at work: $M = 0.31 \pm 0.59$; dispositional anxiety: 28.62 ± 3.89) is characterised by the lowest levels of dispositional anxiety, difficulty with maintaining focus, and number of accidents at work. Firefighters in this group also have relatively short work experience.

Discussion

Researchers indicate that this form of anxiety, specified as dispositional anxiety, is a trait that is most probably of the nature of being drilled into, while also embedded during the course of previous negative experiences. The existing research reports illustrate that the level of anxiety may have an impact on the accuracy of the judges during a judo championship [18]. Performing under stress in life-threatening situations requires a good level of stress tolerance [19].

Spielberger indicates that the formation of anxiety personality may stretch back quite far in past individual experiences, which were received in a negative way, e.g. as punishment [3]. The cognitive processes played a significant role here. Amongst people who experience this anxiety at a high level in situations assessed as threatening, the intensity of the second form of anxiety also rises, namely state anxiety [20]. Simultaneously, it has been noted that the clearest relationship appears between anxiety disposition and state anxiety in situations of “a threat to ego” rather than in situations of physical threat. Hence, this can pose difficulties in terms of assessing the relationship between anxiety disposition and state anxiety, because it is how a situation is interpreted, or in other words, the cognitive aspect frequently constitutes a certain unknown quantity [21, 22]. People who have higher results in terms of the level of anxiety disposition and state anxiety illustrate greater tendencies towards addictions. Amongst women, an increased level of impulsiveness, combined with under-estimation of risk, have been observed [13]. According to Attentional Control theory (trait anxiety’s effects), impaired processing efficiency in high anxiety is mediated through

inefficient executive processes that are required for effective attentional control [23].

The findings of the conducted analysis emphasise the significant meaning of anxiety as a disposition (trait anxiety) in the context of the functioning of people executing tasks in the fire services units, particularly with reference to the risk of accidents and efficiency of actions in stressful situations. Dispositional anxiety plays a significant role in the perception and interpretation of situations that are threatening, which may lead to an increased level of emotional tension, even in situations that are, objectively speaking, highly risky [3]. People of a high degree of trait anxiety have the tendency to react to stimulants of an equivocal nature with unease and increased tension, which results from the increased excitability of the nervous system [24]. A high level of dispositional anxiety may lead to the interpretation of neutral or ambiguous situations as a threat, which may potentially have an impact on the manner of coping in conflict situations [25].

In the research conducted, it has been indicated that difficulty with maintaining focus, while also the length of work experience within the framework of tasks in the fire services, as well as the number of accidents at work, are significantly associated with the level of anxiety as disposition. They indicate high values of the standardised co-factors (beta) and non-standardised co-factors (*B*) of the coefficients of regression (focus). The analysis of regression (Beta = 0.485 for the number of accidents and Beta = 0.276 for the years of work experience of a fire fighter) suggests that the number of accidents at work is a stronger predictor of dispositional anxiety than work experience. Similar findings were noted in research conducted by Brown, Mulhern, and Joseph [7], where it was shown that the greater experience of negative emotions connected with traumatic incidents, particularly in association with the external placement of control, led to a greater level of psychological suffering.

Firefighters of a high level of anxiety are characterised by an increased degree of difficulty with maintaining focus. In subject-based literature, research indicates that people with a high level of anxiety more frequently choose strategies of coping that do not

solve the problem, but concentrate rather on avoiding or minimising emotional discomfort [5].

Conducted analysis of the findings showed three clear subgroups of firefighters who differ in terms of anxiety, difficulty with maintaining focus, and the number of accidents at work. The group with the highest level of dispositional anxiety (Cluster 2) was also characterised by the greatest difficulties with maintaining cognitive focus, as well as the largest number of accidents. These findings are in accordance with the research of Saviola *et al.* [4], who indicated that people of a high level of anxiety display greater difficulties with adapting to the dynamically changing work conditions.

On the basis of the findings acquired, it is possible to draw practical conclusions for stress management in the working environment of firefighters, which increases the risk of the development of post-traumatic stress disorder (PTSD) [9, 26]. Hence, cognitive-behavioural therapy that is concentrated on trauma is recommended for the treatment of PTSD, even though half of the patients do not react to this intervention [27].

That is why there is an urgent need to prepare new strategies to improve the reactions to treatment. Interventions concentrated on the reduction of dispositional anxiety and the improvement of concentration could be particularly valuable. Firefighters from the group of the highest level of anxiety (Cluster 2) should be encompassed by particular care with the aim of minimisation of professional risk and the enhancement of their functioning.

Funding

No external funding.

Ethical approval

Not applicable.

Conflict of interest

The authors declare no conflict of interest.

References

- Ortenburger D, Sikora K, Barczyńska R, Kapuśniak K. Circumstances of intensity of anxiety among firemen – pilot study. *Phys Act Rev.* 2024; 12(1): 95-101.
- Devinatz VG. Feeling the Heat: an Analysis of Illinois Firefighter Strikes, 1968-1980. *Empl Responsib Rights J.* 2015; 27(3): 181-194.
- Spielberger C, Gorsuch R, Lushene R, Vagg PR, Jacobs G. Manual for the State-Trait Anxiety Inventory (Form Y1 – Y2). Vol. IV, Palo Alto, CA: Consulting Psychologists Press 1983.
- Saviola F, Pappaianni E, Monti A, Grecucci A, Jovicich J, De Pisapia N. Trait and state anxiety are mapped differently in the human brain. *Sci Rep.* 2020; 10: 11112.
- Endler NS, Kocovski NL. State and trait anxiety revisited. *J Anxiety Disord.* 2001; 15(3): 231-245.
- Sarason IG. Anxiety, self-preoccupation and attention. *Anxiety Res.* 1988; 1(1): 3-7.
- Brown J, Mulhern G, Joseph S. Incident-related stressors, locus of control, coping, and psychological distress among firefighters in Northern Ireland. *J Trauma Stress.* 2002; 15(2): 161-168.
- Oskwarek PP, Tokarska-Rodak M. Stres w środowisku pracy strażaków. *Rozpr Społeczne.* 2017; 11(2): 57-61.
- McFarlane AC, Bryant RA. Post-traumatic stress disorder in occupational settings: anticipating and managing the risk. *Occup Med (Chic Ill).* 2007; 57(6): 404-410.
- Maramar CR, McCaslin SE, Metzler TJ, Best S, Weiss DS, Fagan J, Liberman A, Pole N, Otte C, Yehuda R, Mohr D, Neylan T. Predictors of posttraumatic stress in police and other first responders. *Ann N Y Acad Sci.* 2006; 1071(1): 1-18.
- Bryant RA. Post-traumatic stress disorder: a state of the art review of evidence and challenges. *World Psychiatry.* 2019; 18(3): 259-269.
- Sayed S, Iacoviello BM, Charney DS. Risk factors for the development of psychopathology following trauma. *Curr Psychiatry Rep.* 2015; 17(8): 612.
- Wrześniewski K, Sosnowski T, Jaworska A, Fecenec D. Inwentarz Stanu i Cechy Lęku. Polska Adaptacja STAI. Warszawa: Pracownia Testów Psychologicznych Polskiego Towarzystwa Psychologicznego; 2011.
- Pacesova P, Smela P, Kracek S. Personal well-being as part of the quality of life: Is there a difference in the personal well-being of women and men with higher level of anxiety trait regarding their sport activity? *Phys Act Rev.* 2019; 7: 201-208.
- Amen D. Change Your Brain, Change Your Body: Use Your Brain to Get and Keep the Body You Have Always Wanted. Harmony Books, New York City 2010.
- Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods.* 2007; 39(2): 175-191.
- Hartigan JA, Wong MA. Algorithm AS 136: A K-Means Clustering Algorithm. *Appl Stat.* 1979; 28(1): 100.
- Kostrzewa M, Supiński J, Kownacki S, Lulińska E, Markowski J, Pilch J, Zak M, Marzec A, Maszczyk A. Differences in judging judo matches between judges with different qualifications, coaches and players. *Phys Act Rev.* 2024; 12(1): 86-94.
- Vit M, Houdek M, Sebera M. Reaction time and stress tolerance of police officers in specific and non-specific tests in professional self-defence training. *Phys Act Rev.* 2019; 7: 193-200.
- Spielberger CD. Conceptual and methodological issues in anxiety research. In: *Anxiety: Current Trends in Theory and Research.* Elsevier 1972; 481-493.
- Spielberg JM, De Leon AA, Bredemeier K, Heller W, Engels AS, Warren SL, Crocker LD, Sutton BP, Miller GA. Anxiety type modulates immediate versus delayed engagement of attention-related brain regions. *Brain Behav.* 2013; 3(5): 532-551.
- Heeren A, Bernstein EE, McNally RJ. Deconstructing trait anxiety: a network perspective. *Anxiety Stress Coping.* 2018; 31(3): 262-276.
- Eysenck MW, Moser JS, Derakshan N, Hepsomali P, Allen P. A neurocognitive account of attentional control theory: how does trait anxiety affect the brain's attentional networks? *Cogn Emot.* 2023; 37(2): 220-237.

24. Tabala K, Wrzesińska M, Stecz P, Mąkosa G, Kocur J. Correlates of respiratory admissions frequency in patients with obstructive lung diseases: coping styles, personality and anxiety. *Psychiatr Pol.* 2020; 54(2): 303-316.
25. Borecka-Biernat D. Ocena poznawcza konfliktu i emocjonalny wymiar strategii radzenia sobie młodzieży w sytuacji konfliktu społecznego. *Ann Univ Mariae Curie-Skłodowska, Sect J Paedagog.* 2020; 33(2): 179.
26. Valenti MA, Farland L V, Huang K, Liu Y, Beitel SC, Jahnke SA, Hollerbach B, St Clair CC, Gulotta JJ, Kollar JJ, Urwin DJ, Louzado-Feliciano P, Baker JB, Jack KL, Caban-Martinez AJ, Goodrich JM, Burgess JL. Evaluating the effect of depression, anxiety, and post-traumatic stress disorder on anti-Müllerian hormone levels among women firefighters. *J Women's Health.* 2025; 34: 354-361.
27. Bryant RA, Dawson KS, Yadav S, Tran J, Choi-Christou J, Rawson N, Tockar J, Stech E, Garber B, Broomfield C, Harrison A, Keyan D, Azevedo S. Augmenting trauma-focused cognitive behavior therapy for post-traumatic stress disorder with memory specificity training: a randomized controlled trial. *World Psychiatry.* 2025; 24(1): 113-119.

Address for correspondence

Jacek Wąsik
Jan Długosz University
Częstochowa, Poland
E-mail: j.wasik@ajd.czyst.pl

Received: 27.01.2025

Accepted: 17.06.2025

Online publication: 17.06.2026