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Effect of traumatic experiences and future threats on executive functioning and verbal fluency amongst Farsi-Dari speaking immigrants, refugees, and asylum seekers

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ABSTRACT

Background: Impairments in executive functioning associated with posttraumatic stress disorder (PTSD) may impact the capacity of refugees and asylum seekers.
Aims: To examine the association between executive functioning and PTSD with and without prominent future-focused threat (FFT) intrusions at rest and after threat priming.
Method: 66 Farsi and Dari-speaking asylum-seekers, refugees, and immigrants were recruited into 3 groups: High PTSD & FFT Symptoms; High PTS Symptoms; Low PTSD & FFT symptoms. The Category Fluency Test (animals; food; flora) in Farsi was administered at baseline and after two counter-balanced future- and past-focused threat narrative tasks. Results: Higher PTSD and FFT symptom scores was associated with reduced verbal fluency [correct words (PTS $p < 0.001$; FFT $p < 0.007$), clustered words (PTS, $p < 0.004$; FFT $p < 0.009$) and clusters (PTS $p < 0.017$; FFT $p < 0.009$)]. The PTSD group retrieved fewer correct words (17.6, $p < 0.009$) using fewer clusters ($p < 0.008$) than the low-symptom group at baseline. It was only after exposure to the narrative task that the FFT group displayed comparable impairment.
Conclusions: A subset of displaced persons with future threat symptoms exhibit cognitive impairment when asked to recount narrative details. Future threat may limit capacity to engage in cognitively demanding activities, such as participating in Refugee Status Determination.

1. Introduction

Deficits in executive functioning associated with PTSD have received increasing research focus (Amick et al., 2013; Havelka Meštrović and Kozarić-Kovačić, 2014; Honzel et al., 2014; Kira et al., 2020; Koso and Hansen, 2006; Lafavor et al., 2022; Maja et al., 2022; Op den Kelder, Van den Akker, Geurts, Lindauer and Overbeek, 2018; Susanty et al., 2022; Woon et al., 2017; Yang et al., 2017). Executive functioning refers to a set of integrated cognitive capacities that facilitate concentration and attention to support executive skills such as planning, problem-solving, reasoning and memory retrieval (Diamond, 2013a; Polak et al., 2012). Impairments in cognitive functioning associated with PTSD have been

documented across a range of populations (Dossi et al., 2020; Gilbertson et al., 2001; Johnsen and Asbjørnsen, 2008; Op den Kelder et al., 2018; Scharpf et al., 2022; Stein et al., 2002) involving domains such as reduced cognitive flexibility, impaired selective attention and inhibition, and reduced working memory and planning capacity (Chris R Brewin, 2007; Kanagaratnam and Asbjørnsen, 2007; Koso and Hansen, 2006; Meewisse et al., 2005).

It is only in recent years that mental health researchers have examined executive functioning amongst displaced and conflict-affected populations (Ainamani et al., 2017; Buckner and Kim, 2012; Johnsen et al., 2017; Scharpf et al., 2022) who have a high risk of exposure to multiple forms of potentially traumatic events (PTEs) (Z. Steel et al.,

2009) and show high rates of PTSD and other mental health impairments (Blackmore et al., 2020; Carpiniello, 2023; F. Charlson et al., 2019; F. J. Charlson et al., 2016; Hoppen et al., 2021; Z. Steel et al., 2009). Documenting the nature and presence of deficits in executive functioning associated with PTSD in this population is likely to have important implications on understanding capacity limitations for refugees, asylum seekers and displaced persons. There is a long-established evidence base demonstrating reduced autobiographical specificity among asylum seekers and increased likelihood associated with PTSD (Graham et al., 2014; Herlihy et al., 2002; Khan et al., 2021) that has been critical to procedural reform in refugee status determination, a process often reliant on review of testimonial evidence (Hunter et al., 2013; United Nations Hgh Commissioner forUnited Nations, 2017). The decision making setting assume the capacity of an individual to outline past experiences of persecution and ongoing protection needs, skills that are als]o likely to be highly dependent on an individual's executive functioning capacity (Campbell, 2020; Smith-Khan, 2019; Z Steel et al., 2011).

Undertaking research to examine executive functioning amongst refugees and asylum seeker populations faces a number of key challenges, including the identification and use of measures that have evidence of cross-cultural validity. This is further compounded by the fact that many refugees come settings that have been subject to long periods of political instability, underdevelopment, and interrupted education. Tests of verbal fluency have emerged as one of a range of neuropsychological measures used to assess interrelated executive functioning processes such as problem-solving, reasoning, planning, cognitive flexibility and working memory (Diamond, 2013b; Martínez-Pernía et al., 2023; Miyake et al., 2000; Op den Kelder et al., 2018). Verbal fluency has been used extensively within cross-cultural settings (Burgess et al., 1998; Evans, 2022; Faber et al., 2022) making it a potentially useful measure of executive functioning amongst population groups such as asylum seekers and refugees (Giovannoli et al., 2023). Semantic or category forms of verbal fluency that focus on the ability of an individual to name types of food or animals is less dependent on literacy than other forms of verbal fluency and executive functioning assessment (Kavé et al., 2011; Nielsen & Waldemar, 2016; Ratcliff et al., 1998; Shariat et al., 2022; Shirdel et al., 2022). A number of studies have also demonstrated reductions in verbal fluency due to reductions in PTSD symptoms (Best et al., 2009; Brucki and Rocha, 2004; Diamond, 2013a; Miyake and Friedman, 2012; Op den Kelder et al., 2018).

A potentially important and highly relevant area of research within the broader field of PTSD, memory and cognition is the link between problems in imagining future events and remembering the past in specific terms (Brown et al., 2014). It is thought that the association between these two executive functioning deficits might arise from the activation of the same cortical regions (Addis et al., 2007; Botzung et al., 2008; Brown et al., 2014; Okuda et al., 2003; Rubin, 2014). An emerging notion is that there is an additional impact on executive function related to future-oriented threat-related symptoms (Future focused threat (FFT), in addition to the impact of past focused threat (i.e., PTSD symptoms).

This may be of particular relevance for asylum seekers as decision makers are required to make a prospective assessment of the future likelihood that persecution, as outlined under the Convention, may face the refugee status determination applicant (Foster et al., 2022; United Nations, 1951). This future-oriented assessment frequently occurs in an 'evidentiary gap' (Herlihy et al., 2002; Herlihy and Turner, 2009; Ibrahim et al., 2019). Executive function, in particular verbal fluency, are essential skill needed to communicate both past and future threats to refugee status-determination decision-makers (Koso and Hansen, 2006; LaGarde et al., 2010). People seeking asylum often live with ongoing future threats associated with visa insecurity (Fazel et al., 2012; Rostami et al., 2022) that may lead to additional impact on functional capacity.

The aim of this research was to examine if verbal functioning capacity was associated with symptoms of traumatic stress, ongoing traumatic threat associated with asylum stress and in response to a life

narrative procedure task that engage past and future trauma narratives. Each of these associations have relevance to better understanding possible interactions between executive functioning, psychological vulnerability, and task demands that will present in the contexts of refugee status determination. This study recruited refugees, asylum seekers, and immigrants participating in a larger prospective study of Farsi- and Dari-speaking asylum seekers, refugees and immigrants who had arrived in Australia within the last 10 years. The design of the research examined indices of verbal fluency impairment among those reporting high future-and past-focused threat (FFT), high past-focused threat symptoms only (post-traumatic stress - PTS) and those reporting low threat symptoms (Low symptom group). We applied a semantic verbal fluency task to assess executive functioning that has previously been applied with Farsi speaking populations (Brucki and Rocha, 2004; Ghasemian-Shirvan et al., 2018). We further incorporate an autobiographical threat activation procedure to examine threat provocation on verbal fluency. Verbal fluency was measured at baseline and then two more times, each after one of two provocation tasks counter-balanced for future and past focus threats. It was anticipated that the FFT group which primarily comprises asylum seekers would be primed towards future threats given their visa insecurity with the group with primarily PTSD symptoms activation more directly linked to past threat reminders.

We, therefore, hypothesised that, at baseline, people in the FFT group and the PTSD group will show verbal fluency deficits compared to the Low PTSD/FFT group. We further hypothesised that PTSD and FFT symptoms severity will be associated with verbal fluency and verbal productivity deficits. In addition, controlling for PTS symptoms, we hypothesised that there would be an association between the FFT symptoms and verbal fluency and verbal productivity. Two experimental hypotheses were investigated. Firstly, that exposure to the provocation tasks would result in individual reductions in verbal fluency and verbal productivity for the symptom groups relative to the Low group. Secondly, those in the FFT group would show greater reductions in verbal fluency scores in response to the future-focused provocation task than those in the PTS group, who will show greater reductions compared to the Low group.

2. Methods

The study design, procedure, hypotheses, and proposed analyses were preregistered with the online OSF registry to confirm the implementation of a hypotheses driven deductive research program (https://osf.io/v8y75).

2.1. Participants

Participants for this study were drawn from a larger cohort of 411 of adult refugees, asylum seekers and immigrants from Farsi and Dari-speaking backgrounds have arrived in Australia between 2010 and 2017 enrolled in a 5-year longitudinal epidemiological study, UNSW HREC approval number - HC16637, *The Reassure Study*. We invited participants in the Reassure study whose most recent survey scores indicated that their combined PTSD symptom and FFT symptom scores placed them into one of the three symptom groups (FFT, PTSD or Low) which was confirmed by re-administration of these measures prior to participation. Reassure Cohort participants with PTS and FFT symptoms above 2.2 were sequentially invited to join the FFT group until the group was filled. For the low group, people with the lowest PTS and FFT symptoms were sequentially invited until the group was filled. For the PTS group, a discrepancy score was generated by subtracting FFT scores from PTS and participants with the largest discrepancy (PTS score being larger) and a minimum difference of 0.3 were sequentially invited. There was a smaller number of participants eligible for this group.

Power analyses conducted in G-power version 3.1.9.7. (Faul et al., 2007) indicated a sample size of 65 to achieve 95% power for a

two-tailed rejection rate of 0.05 with a 3 (Time: baseline; post provocation 1; post provocation 2) x 3 (Group: FFT; PTSD; Low) was required for a small to moderate effect size of 0.5.

2.2. Procedure

Participants enrolled in the Reassure Cohort Study who consecutively met study inclusion criterion were sent an invitation to participate in the survey. Those who responded to the invitation were readministered the PTS and FFT scales to confirm group membership by one of the Reassure team members. The researcher conducting this study then visited eligible consenting respondents to administer the experimental session. The session commenced with the phenomenological emotional rating to establish baseline mood state, followed by the first administration of the Category Fluency test (CFT, animals); Participants then completed one of two narrative provocation tasks, one future focused, and one past focused. After each narrative task, participants completed a further CFT (in the order of food and flora) and a phenomenological emotional rating. The order of narrative provocation tasks was randomly counterbalanced to control for order. The researcher who conducted the experiment was blind to which symptom group the participants were allocated to. All participants were provided with a $100 reimbursement for the time involved in participoating in the research. We believed this an appropriate compensation to acknowledge the time spent, without placing participants in situations of dependence or coercion. Due to the impact of COVID study recruitment was undertaken in two phases: Oct 2019–March 2020; and April 2022–May 2022.

2.3. Materials

Demographic variables – This information included the participants' age, gender, religion, country of origin, marital status, education, detention duration, and visa status.

Posttraumatic stress disorder The Harvard Trauma Questionnaire (HTQ) was used to measure symptoms of PTSD. The HTQ (Mollica et al., 1992; Shoeb et al., 2007) has been used extensively in international refugee populations (Morina et al., 2018; Nakimuli-Mpungu et al., 2013) to measure PTSD symptoms during the last 7 days. We applied a 20-item version that has included additional symptoms to cover DSM 5 item measure of PTSD Symptoms was used (Silove et al., 2014), and participants rated each symptom on a four-point scale in terms of how troubled they were by the symptom in the past week (1 = not at all, 4 = extremely). We applied a Farsi–Dari translation of the HTQ scale that had been previously developed (Momartin et al., 2006; Steel et al., 2011a,b). The total average total score was used.

Future Focused Traumatic Threat (FFT). The Future Focused Traumatic Threat Questionnaire was developed by the research team to measure symptoms associated with future-focused traumatic threats. It measures nine traumatic threat-related intrusion and avoidance symptoms with the temporal orientation shifted to future-focused potentially traumatic events, items included *recurrent thoughts about terrifying events happening to you or to someone close to you*; *recurrent nightmares about these possible future events*; *intense feelings of fear or horror in response to thoughts or images about these possible future events*; *avoiding thoughts or conversations that remind you of the possibility that these future events may happen.* FFT items were assessed on the same 4-point response format as the HTQ.

Verbal Fluency. Verbal fluency can be assessed using semantic procedures that require participants to recall words commencing with a specific letter or using categories such as recalling names of animals. We decided to assess category fluency because it is less dependent on language and is culturally adaptable. The Category Fluency Test (CFT) has been widely used as a rapid measure of executive function, verbal fluency and to detect cognitive impairment in both English and Farsi (C. R. Brewin, 2001; Brucki and Rocha, 2004; Ghasemian-Shirvan et al., 2018; Hermans et al., 2006; R. J. McNally, 2006; Stevens et al., 2013);

Participants are asked to recall as many items within a given category as they can within 60 s. In this study, three culturally relevant parallel forms were used (animals; food; Flora items).

The total number of correct words has been used as a measure of overall verbal fluency, which has previously been associated with executive function and attention performance (Brucki and Rocha, 2004; Shandera-Ochsner et al., 2013). In addition, we applied a scoring methodology adapted from van den Berg et al. (2017) and Levine et al. (2002). Responses were coded for the number of conceptual clusters and the total number of clustered words. The total number of clustered words provides a measure of strategic verbal fluency while the number of clusters reflects strategy flexibility both of which are reflective of executive functioning capacity. Number of clusters and total cluster size has been previously shown to correlate with language, memory, and processing speed domains of cognitive function (Brucki and Rocha, 2004; Farghaly et al., 2018; Shao et al., 2014). A limitation of the number of clusters is the impact of different forms of the test with category formation easier for categories such as animals compared to flora used in the current research. The original coding rules were adapted to ensure relevance to Farsi and Dari samples of verbal fluency answers to generate a coding rule book appropriate to these languages. Two bi-cultural researchers with extensive knowledge of the relevant cultures and languages independently scored the verbal fluency measures and then met to resolve inconsistencies. This iterative cross-coding process was continued until the coders demonstrated high agreement in scoring (AUC >0.9). Once the agreement was reached, the remaining items were scored by one bi-cultural researcher. Analyses controlled for age as research has demonstrated an age-related decreases in verbal fluency (Bolla et al., 1990; Crossley, D'Arcy and Rawson, 1997; Kosmidis et al., 2004; Rodríguez-Aranda and Martinussen, 2006; Troyer, 2000; Zarino et al., 2014) and a positive effect of education on semantic tasks has been found (fruits, vegetables, and animals) (Chávez-Oliveros et al., 2015; Hall et al., 2007; Kempler et al., 1998).

Future- and Past-focused Narrative Tasks. The Life Narratives Interview (Sansom-Daly et al., 2018) asks participants to recall 5 specific events prompted by key words and describe them to the researcher. The task begins with the participant choosing key words of personal significance and writing these on a card to prime the participant to consider events that relate to their own life and values. They are then asked to think of 5 events that have or will shape who they are as a person and write each on a card to remind them. These cards are then placed in chronological order and the participant is asked to spend 20 min integrating these specific events into a life story which likely includes details about each of the specific events. For participants with traumatic stress, being asked to recount past or imagine future events of personal significance in specific detail is to activate traumatic memories or prospection, and thus will act as a provocation task.

Emotional-Phenomenological Assessment: Participants also completed a phenomenological emotional task which served as a manipulation check to determine whether the provocation was followed by positive or negative emotional reports. To measure this impact on participant's emotional state, a set of culturally tailored Farsi words to describe a range of emotions were selected by an expert panel of Farsi speaking academics and clinicians. At the baseline level, the Participants rated their current emotional state out of 100 to all 28 emotional words. After each provocation task the participants were provided with the same emotional task. However, this time the task took on a different form. The emotional words were presented to them in a wheel, and they were asked to choose the three major feelings that they were experiencing in that instance and rank them from 1 to 3. The responses were recoded to a binary variable based on median split to indicate the presence or absence of negative emotions following each narrative task.

Institutional ethics review: The current research was reviewed by the University of NSW, institutional Human Research Ethic committee do ensure that this research comply with international standard of research practice (HC190354).

Positionality statement: Author, CI is a 64-year-old man raised in Iran and living in Australia. He completed his masters level psychology studies in Iran and is currently a HDR student at the University of NSW, Australia. RF, DB, ZS are Clinical Psychologists and Academics who undertook their training in psychology in Australia. AS, RE, NI are Farsi-Speaking postgraduate students n Australia who assisted with aspect so the training and verbal fluency coding. RF assisted with access to the participants who took part in the Reassure Study. NI is related to CI and assisted with data coding and testing. All data coding was undertaken blind to participants group status. In reporting on this study we acknowledge our privileged access to specific resources not available to all participants many of whom were asylum seekers. CI, AS, RE, NI bring our cultural heritage and professional development to interpret the verbal fluency data and the findings. We have strived to be aware of our biases and to not make assumptions based on only on experiences and opinions.

2.4. Analysis

Frequencies and means for demographic variables were calculated for each of the study groups. To test the hypothesis that there would be a difference between the low and two high symptom groups at baseline, a one-way ANOVA examined group differences in CFT controlling for age and education. For each dependent variable, Bonferroni correction was used to control type 1 error at 0.05. For remaining analyses, to enable comparison between verbal fluency parallel forms over time, scores were converted into z-scores. To test the hypothesis that PTS and FFT severity would be associated with verbal fluency and verbal productivity, bivariate partial correlations examined relationships between continuous measures of PTS and FFT and verbal fluency and verbal productivity. These partial correlations controlled for age and education. To test the hypothesis that controlling for PTS symptoms there will be a relationship between FFT symptoms and verbal fluency, we used path analyses in Mplus 8.0. The path analysis examined the paths from FFT symptoms to verbal fluency (separate model for each verbal fluency measure) and whether this path was mediated by PTS symptoms using maximum likelihood estimation. See Fig. 1. To test the hypothesis that exposure to the provocation tasks would result in individual reductions in verbal fluency and verbal productivity for the symptom groups relative to the Low group we applied a mixed model approach. A 2 between (past/future focused tasks order) x 3 within (Time: Baseline; following future task; following past task) x 3 between (Symptom Low; PTSD and FFT groups) mixed models, controlling for negative emotion with autoregressive covariance structure was conducted for each CFT variable. For the verbal productivity variable (total words produced) there were only 2 time points as the words were produced in each of the two narrative tasks. Specified linear and quadratic interaction contrasts examined whether, compared to the low symptom group, the PTSD and FFT groups show greater provocation-related reductions in verbal fluency. An interaction term between time and order was used to test order of administration.
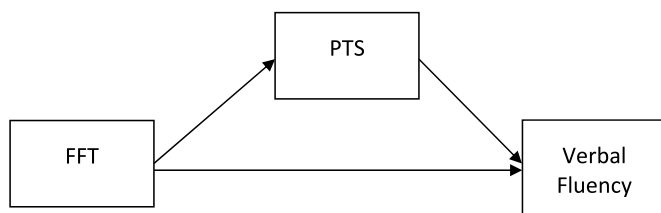
3. Results

Table 1 presents the sociodemographic characteristics of the 66 participants stratified by the three groups, (PTSD; FFT; and low symptom) and by the order of administration of the future and past focused tasks. There were no differences between groups regarding age, gender, education, marital status, and trauma count. A significant difference between symptom groups in religious affiliation ($p < 0.032$) and visa status ($p < 0.018$) was evident. The FFT group included more participants identifying as Christian and the PTSD group included more participants identifying as Muslim. In terms of asylum status, reflecting an objective measure of future threat, the FFT group had the highest number of asylum seekers (16/25, 70%), followed by the PTSD group (7/14, 50%) and the low symptom group (8/31, 31%). There were significant differences between the symptom groups in levels of PTSD ($p < 0.001$) and FFT symptoms ($p < 0.001$) in the order expected by group selection. There was a significant difference between symptom groups in the order of administration of past vs future interviews ($\chi2 < 0.009$). There were no differences in sociodemographic characteristics based on order of administration of interviews.

3.1. Baseline group differences

Table 2 presents means, and standard errors of CFT results between symptoms groups at the initial baseline assessment before the future and past narrative provocation procedure controlling for age and education. Groupwise tests indicated significant differences between groups in the total correct words ($p < 0.021$) and the number of clusters used ($p < 0.024$). Multiple comparisons with Bonferroni correction found that the PTSD group had a lower number of total correct words ($p < 0.009$) and clusters used ($p < 0.008$) than the low-symptom group. There were no significant differences between the FFT group from the low group.

3.2. Studywise associations

The association between the verbal fluency measures and symptom measure (aggregated across administrations ×3 for CFT and ×2 narrative task) were calculated using mixed models, controlling for age and education, and considering non-independence of association between parallel forms of the CFT (Table 3). These were aggregated across all assessment occasions including baseline and provocation results. There were significant correlations between PTSD symptoms and all verbal fluency measures [total correct words ($p < 0.001$), total clustered words ($p < 0.004$) and the number of clusters ($p < 0.017$)]. There were significant correlations between FFT symptoms and all verbal fluency measures [total correct word ($p < 0.007$), total clustered words ($p < 0.009$) and the number of clusters ($p < 0.03$)]. The total number of words produced during the narrative task was significantly associated with PTSD symptoms ($p < 0.003$) but not FFT symptoms.

3.3. Path analysis

Table 3 presents the coefficients of the 4 paths associated with the model outlined n Fig. 1 for each of the CFT measures (total correct words; total clustered words; number of clusters) and associated significance levels. The data displayed non-significant kurtosis and was centrally distributed supporting maximum likelihood estimation with the model being fully identified precluding use of goodness of fit statistics. For the total correct words, there was a significant path from PTS to total correct words, and from FFT to PTS, there was also a significant indirect path from FFT symptoms, through PTS symptoms to total correct words. There was no direct relationship between FFT symptoms and total correct words with the association being fully mediated by PTS symptoms. For the number of clusters and the total number of clustered words, the only significant path was from FFT symptoms to PTS symptoms. The bivariate correlations between FFT symptoms and the number

Fig. 1. Path Analysis of the relationship between verbal fluency, PTSD symptoms and FFT symptoms.

Table 1
Sociodemographic characteristics.

Variable	categories	Symptom Groups			Sig.		Order		Sig.	
		FFT	PTS	Low			PAST first	Future First		
		n (%)	n (%)	n (%)	χ2	p	n (%)	n (%)	χ2	p
		25 (38)	14 (21)	27 (41)						
Gender	Female	5 (21)	7 (50)	12 (46)	4.6	0.1	14 (42)	9 (30)	1.05	0.306
Education	Finished University	7 (30)	6 (46)	12 (46)	1.8	0.408	13 (41)	12 (40)	0.003	0.96
Country of Origin	Iran[a]	24 (100)	10 (83)	24 (92)	3.8	0.15	31 (93)	27 (96)	0.2	0.654
Religion	Islam	3 (12)	6 (46)	3 (11)	10.6	**0.032**	5 (15)	6 (20)	0.4	0.82
	Christian	11(44)	3 (23)	7 (26)			12 (35)	9 (30)		
	Other[b]	11 (44)	4 (31)	17 (63)			17 (50)	15 (50)		
Marital	Married[c]	7 (29)	9 (64)	11 (42)	4.5	0.107	14 (42)	12 (40)	0.04	0.845
Visa	Bridging or no visa[d]	17 (71)	7 (50)	8 (31)	8	**0.018**	15 (46)	17 (57)	0.8	0.374
Detention	Yes	16 (67)	3 (27)	15 (58)	4.8	0.09	16 (50)	18 (64)	1.2	0.265
Order of administration	Future First	11 (44)	11 (85)	9 (33)	9.5	**0.009**				
		Mean (SD)	Mean (SD)	Mean (SD)	F	p	Mean (SD)	Mean (SD)	F	p
Age		42 (10)	45 (10)	39 (7)	1.8	0.167	42 (9)	40 (9)	0.6	0.429
Trauma Count		4 (0.8)	3 (0.8)	5 (0.9)	2.1	0.134	6.3 (4)	7 (4)	0.5	0.494
PTSD Symptoms		2.5 (0.6)	2.4 (0.4)	0.6 (0.4)	114.5	**<0.001**	1.5 (1)	1.9 (1)	2.5	0.119
FFT Symptoms		2.7 (0.6)	1.8 (0.5)	0.8 (0.5)	72.1	**<0.001**	1.7 (1)	1.8 (1)	0.2	0.699

Table 2
Baseline group differences in Verbal Fluency controlling for age and education.

Category	Measure	Symptom Groups					FFT vs Low	PTS vs Low
		FFT	PTS	Low				
		Mean (SE)	Mean (SE)	Mean (SE)	F	p	P	p
Animals	Total correct words	23 (1.3)	17.6 (1.9)	23.8 (1.3)	4.14	**0.021**	0.815	**0.009**
	Total clustered words	19.4 (1.5)	13.7 (2.2)	19.6 (1.5)	2.9	0.061	0.897	0.027
	Number of clusters	6.5 (0.5)	4.4 (0.7)	6.8 (0.5)	3.9	**0.024**	0.649	**0.008**

Note. Verbal Fluency scores on the CFT for total correct words recalled, number of conceptual clusters and total words recalled within a conceptual cluster.

Table 3
Correlations between verbal fluency measures and path analysis between verbal fluency, FTT symptoms and PTS symptoms.

		Category Fluency			
		Total Correct	Clusters	Total Clustered	Total Words in Narrative Task
PTSD symptoms	beta	−0.25	−0.17	−0.21	−0.26
	p	**0.001**	**0.017**	**0.004**	**0.003**
	df	184	184	184	122
FFT Symptoms	beta	−0.20	−0.16	−0.19	−0.18
	p	**0.007**	**0.03**	**0.009**	0.053
	df	184	184	184	122
Path Analysis		Total correct words	Number of Clusters	Total clustered words	
		Beta	*Beta*	*Beta*	
PTS symptoms → FFT Symptoms		0.896**	0.896**	0.896**	
PTS symptoms → Verbal Fluency		−0.412**	−0.205	−0.287	
PTS Symptoms→ FFT Symptoms → Verbal Fluency		−0.366**	−0.183	−0.257	
FFT symptoms → Verbal Fluency		*0.018*	*0.033*	*0.069*	

Note: *p < 0.05; **p < 0.01. Association between symptom variables (PTSD or FFT symptoms) and verbal fluency variables (Total correct word; total number of conceptual clusters; total number of words within clusters; total number of words produced in the narrative task). Analysis conducted in mixed models including verbal fluency scores from all three time points (2 time points for words produced), clustered by participant to account for non-independence of observations and controlling for age and education. Path Analysis results depict the Beta for the relationship between variables in the path diagram depicted in Fig. 1.

of clusters or total clustered words were no longer significant after taking PTS symptoms into account, but there was not a significant indirect effect.

3.4. Repeated time mixed models' analysis

A 2 (past/future) between x 3 (Time: Baseline; following future task; following past task) within x 3 (Symptom: Low; PTSD and FFT groups) between mixed model controlling for negative emotion following the narrative tasks was run for each of the 3 CFT variables. The significant effects from the repeated time mixed model analysis for each CFT variable are presented in Table 4. The estimated marginal means in verbal fluency at each time point are reported in Table 5. Estimated marginal means broken down by order of administration are presented in Supplementary Table 1. There was no effect for order of administration (p = 0.426) or order of administration by change over time (p = 0.362).

For total correct words and total clustered words, there was a significant difference between the symptom groups (p > 0.01), in the way that groups changed over time (p = 0.05 & p = 0.028). Specified interaction contrasts examined whether, compared to the Low group, the PTSD and FFT groups showed greater provocation-related reductions in Verbal Fluency across the 3-time points. Comparing FFT to the low group, the FFT group showed a different pattern of change over time, which was accounted for by a quadratic effect (p = 0.035 and p = 0.031). There was no difference between PTSD and Low groups in change over time. There was a significant difference between PTSD and FFT groups in change over time, accounted for by a quadratic effect (p = 0.023 & p = 0.042).

In number of clusters, there were significant difference in symptom groups (p > 0.098) and FFT Vs PTSD linear (p > 0.030). All other effects were non-significant. For total clustered words, there was a significant deference amongst symptoms group (p > 0,007), an interaction between

Table 4
Mixed effects models for verbal fluency scores across three timepoints by symptom group and order of administration.

		Group	Time	Group x Time	Order	Order x time	Negative emotion x time	FFT vs Low Linear	PTS vs Low Linear	PTS vs Low Quadratic	FFT vs PTS Linear	FFT vs PTS Quadratic	FFT vs PTS Quadratic
Total correct words	F	**5.2**	0.1	**2.5**	0.7	1.1	0.3	1.3	**2.1**	0.3	0.5	1.5	2.3
	P	**0.008**	0.899	**0.050**	0.413	0.331	0.838	0.201	**0.035**	0.767	0.614	0.131	0.230
Total Clustered Words	F	**5.3**	2.6	2.8	1.0	1.1	2.6	1.9	**2.2**	0.2	0.3	1.7	2.1
	P	**0.007**	0.080	0.280	0.322	0.350	0.055	0.052	**0.031**	9.060	0.748	0.088	0.420
Number of clusters	F	2.4	1.2	1.8	0.6	1.4	1.4	0.6	1.5	1.7	0.1	**2.2**	1.2
	p	0.098	0.300	0.125	0.436	0.244	0.256	0.584	0.144	0.096	0.939	**0.030**	0.281
Total words – Narrative Tasks	T	**3.7**	3.5	0.3	0.4	0.1	0.1	0.8	–	0.7	–	0.2	–
	p	**0.032**	0.066	0.745	0.555	0.904	0.889	0.460	–	0.451	–	0.866	–

Table 5
Estimated marginal means in verbal fluency at each time point.

		FFT	PTS	Low
Category Fluency Test		Mean (SE)	Mean (SE)	Mean (SE)
Total correct words	baseline	0.129 (0.2)	−0.765 (0.28)	0.253 (0.19)
	test 1	−0.279 (0.2)	−0.305 (0.28)	0.480 (0.18)
	test 2	−0.082 (0.2)	−0.505 (0.28)	0.377 (0.18)
Number of clusters	baseline	0.101 (0.2)	−0.763 (0.29)	0.179 (0.21)
	test 1	−0.173 (0.21)	−0.224 (0.29)	0.355 (0.19)
	test 2	−0.102 (0.21)	−0.086 (0.29)	0.111 (0.19)
total Clustered words	baseline	0.141 (0.96)	−0.823 (0.28)	0.135 (0.20)
	test 1	−0.238 (0.20)	−0.285 (0.28)	0.504 (0.18)
	test 2	−0.134 (0.20)	−0.510 (0.28)	0.361 (0.18)
Life Narrative Interview				
Total words	test 1	909.3 (91.2)	654.5 (144)	1017.1 (95.8)
	test 2	592.6 (92.6)	348.9 (144.5)	776.3 (96.3)
Manipulation Check		n (%)	n (%)	n (%)
Negative emotion	baseline	15 (60)	8 (57)	7 (26)
	test 1	20 (80)	11 (79)	20 (74)
	test 2	18 (75)	11 (79)	18 (67)

Note. Controlling for negative emotion at each timepoint and order to temporal focus of life narratives interview. Z scores are presented for CFT results to allow comparison between parallel forms (animals, food and flora). Total words produced in the narrative tasks are presented as number of words.

symptom groups and time (p > 0.028), FFT VS Low group Quadratic (p > 0.031), FFT VS PTSD Quadratic (p > 0.042). There was no significant effect for other comparisons.

Only two-time points were available for the total number of words produced during the autobiographical tasks. Accordingly, we specified a 2 x (past/future focused tasks order) between x 2 (Time: following future task; following past task) within x 3 (symptom: low; PTSD and FFT groups) between mixed model, controlling for negative emotion following the narrative tasks were run for the total number of words produced in the narrative task. We found no effect on the order of administration or interaction between demand and time. However, for total words made, there was a significant effect for the group (p = 0.032) and a trend for the group by time interaction (p = 0.066). There were no other significant effects. (Table 4).

3.5. Descriptive review of category fluency test

The three symptom groups' performance in the category fluency test in the different timelines was shown in the Supplementary Figs. 1 and 2 and Table 5. According to Supplementary Fig. 1, the PTSD group recalled the lowest correct words in all three-order time, baseline, after the future and past narratives. The low-symptom group presented the highest number of correct words compared to the other two groups in all three trials. However, the FFT group recalled total words more than the PTSD group and less than the lowest group in all three times.

Supplementary Fig. 2 shows the number of clusters of the three groups in each stage. Again, the Low group performed the best in all three times, and the PTSD group presented the lowest number of clusters. The number of total clustered words in the low group was approximately three times more than two other groups. In comparison, the FFT group showed the same as the Low group in the baseline and the same as the PTSD group after the two provocation tasks, still higher than the PTSD group. According to Supplementary Fig. 2, the PTSD group always had the lowest recalling. The Figure also shows that the FFT group recalled clustered.

4. Discussion

This study examined associations between PTSD symptoms, future-focused threat (FFT) related intrusions and measures of executive functioning amongst a cohort of Farsi-Dari-Speaking immigrants, refugees and asylum seekers who had arrived in Australia within the last 10 years prior to the research. We also examined the impact of a future- and a past-focused narrative provocation task on baseline verbal fluency capacity for each of the 3 symptom groups. Key strengths of the study include pre-registration of the research protocol to ensure a commitment to a hypothesis-based analysis. Executive functioning was assessed using a category fluency task (CFT) applying scoring criteria that enabled the calculation of total verbal fluency, the number of words retrieved in clustered groups reflecting organised retrieval strategy, the total number of clusters used to retrieve words reflecting cognitive flexibility (Troyer et al., 1997), and level of verbal production within a life narrative task (D'Argembeau and Mathy, 2011). Three Farsi-Dari alternative forms of the CFT were used to assess verbal fluency at baseline and after participation in a past- and future-focused narrative trauma provocation task. Performance on the CFT was evaluated for three symptom criteria groups recruited from a larger cohort study of Iranian and Afghani asylum seekers, refugees and immigrants who had arrived in Australia since 2010. The three groups comprised a high posttraumatic stress symptom group (PTS); a high posttraumatic stress symptom group also reported frequent distressing future-focused threat intrusions (FFT) and a low PTS and FFT refugee and asylum seekers symptom group (Low).

Associations between traumatic stress and measures of executive functioning amongst refugees and asylum-seekers have been comparatively under-researched despite this group being most likely to encounter high-demand settings within the refugee determination

process that place demands on these cognitive resources. The emergent research has found a general association between PTSD and trauma exposure amongst forcibly displaced populations and deficits in executive functioning (Ainamani et al., 2017; Buckner and Kim, 2012; Johnsen et al., 2017; Kanagaratnam and Asbjørnsen, 2007; Scharpf et al., 2022), working memory (Ainamani et al., 2017; Johnsen et al., 2017; Kanagaratnam and Asbjørnsen, 2007; Scharpf et al., 2022) cognitive flexibility (Buckner and Kim, 2012; Scharpf et al., 2022) (CF), inhibitory control (Scharpf et al., 2022) and automatic processing (Johnsen et al., 2017; Kanagaratnam and Asbjørnsen, 2007). The research to date has focused on general capacity impairment and not functioning during threat related contexts. This is, hence, the first study to examine for dynamic associations between posttraumatic stress responses and executive functioning under a provocation paradigm with a refugee and asylum seeker population.

The result of PTS group performance has been reported by several studies in which PTS impacts cognitive performance, causing attention deficit, weak memory performance, prefrontal functions (Eren-Koçak et al., 2009), and lower working memory and executive function (Op den Kelder et al., 2018). Koso and Hansen also found deficits in sustained attention, working memory, and short-term episodic memory caused by PTSD (Koso and Hansen, 2006). Executive function deficits, including verbal fluency, have been shown in people with PTSD (Woon et al., 2017). The impact of Trauma Events (TE), either in PTSD or non-PTSD groups, on cognitive disfunction and memory performance (Blix and Brennen, 2011; Yehuda, 2002) with evidence of a prolonged neurocognitive deficits and memory impairment reported by several studies (Chris R Brewin, 2007; Conway and Pleydell-Pearce, 2000; Richard J McNally et al., 2003; Rubin et al., 2008). These findings are also consistent with results from a larger group of studies that demonstrate the impact of PTSD and trauma exposure on letter fluency and category fluency functioning as a measure of executive functioning (Boone et al., 1998; Gil et al., 1990; Henry and Crawford, 2004; Massey et al., 2015; Shandera-Ochsner et al., 2013; Tombaugh et al., 1999).

It was of note that we did not find evidence of the same level of impairment in measures of VF for the FTT group at baseline despite this group enduring similar levels of PTSD symptoms during the previous week. Possible reasons for this will be further explored below. However, the study findings when averaged across all time points confirmed that both the PTS and FTT were significantly correlated with the total number of correct word produced, the total number of clusters used and total words within clusters. Taken together the results do provide evidence of a broad association between the PTSD symptom and executive function deficit providing that is consistent with the hypothesis of a strong association between PTS and FTT severity with lower levels of VF.

Multiple studies on refugees and asylum seekers' mental health have indicated that they encounter difficulties in memory functioning and now also in cognitive performance due to various trauma exposures (Fazel et al., 2012; Stevens et al., 2013). Accordingly, they may experience an array of impairments in future-oriented threat, intrusive thought, overgeneral autobiography memory, executive function, emotions, and feelings. Given the growing literature, recognising the challenges of continuous traumatic stress environments (Nuttman-Shwartz and Shoval-Zuckerman, 2015; G Straker, 1987; Gillian Straker, 2013), which is highly relevant to the asylum-seeking context (Z Steel et al., 2011a,b) it is surprising that previous research examining executive functioning deficits amongst refugee and asylum seeker populations has focused primarily on general capacity impairment and not examined functioning during threat-related contexts. The current study is the first to examine for possible dynamic associations between posttraumatic stress responses and executive functioning under a provocation paradigm with a refugee and asylum seeker population. Notwithstanding our hypothesis that exposure to the provocation tasks would reduce verbal fluency and productivity in the symptomatic groups, we did not identify noticeable additional deterioration within the PTSD group. This result may partly be explained by the substantial

baseline deficits in verbal fluency evident for the PTSD group at baseline, providing a floor effect with a pattern of sustained low performance following the provocation tasks continuing across subsequent assessment occasions (see Supplemental Figs. 1 and 2). A similar pattern was evident for the low symptom group with performance being broadly stable across all assessment occasions with no evidence of an adverse impact from the memory provocation tasks.

We examined the potential role of intrusive future-focused traumatic stress symptoms (FFT) (Berntsen and Rubin, 2015; Deeprose et al., 2011) and traditional past-focused PTSD symptoms. Unlike either the PTSD group or the low-symptom group, the PTSD and FFT group displayed a dynamic pattern of verbal fluency functioning that changed iteratively across the study procedure. We hypothesised that this group would show a similar level of verbal fluency as the PTSD group at baseline. This hypothesis was not confirmed with the FFT group having verbal fluency functioning levels at the baseline assessment that were similar to the low-symptom group, despite reporting an equivalent level of past week PTSD symptoms as the PTSD group. In partial confirmation of the primary experimental hypothesis, the FFT group markedly deteriorated verbal fluency following the narrative task.

PTSD has been conceptualised as a disorder that can arise following exposure to one or a series of traumatic events that results in pervasive impairment associated with the ongoing PTSD symptoms. It is well known that some intrusive symptoms are normative during and in the immediate aftermath of trauma. Therefore, when individuals are placed under chronic future threat, the symptoms associated with that threat may substantially resemble PTSD. To this extent, it may be possible that the pattern of responses identified within this study for the FFT group may be identifying a pattern of responding to traumatic threats that can be misunderstood as PTSD. It would be consistent with a model that would see the PTS and FFT symptoms as part of an adaptive warning signal (Ehlers et al., 2002; Silove, 1998) rather than harmful dysfunction that is essential to the concept of PTSD (Wakefield, 2016; Wakefield and Horwitz, 2012).

In addition, the associations of FTT with VF were examined using a path analysis for controlling PTS symptoms. The path coefficients demonstrated significant correlations between FTT and PTS, and found that PTS fully mediates the relationship between FFT and VF. As such, the results did not support Hypothesis 3, which stated that once a control for PTS is established, there will be a strong correlation between FTT and VF. The reported mediation path analysis findings suggested the almost complete symptomatic overlap between FFT and PTS symptoms, contrary to our initial hypothesis, with any association between FFT and verbal functioning fully mediated via PTSD symptoms. It was only under the provocation protocol that manifests differently in the PTSD only, and PTSD + FFT groups became apparent. The PTSD group, which we argue represents a classic PTSD presentation, displayed pervasive impairment in executive functioning. In contrast, the FFT group appeared to broadly indicate impairment in executive functioning only? when confronted with past or future focused threat reminders. Still, it did not seem to have the same pervasive impairment. This finding may account for the strong relationship between PTSD symptoms and insecure residency that appears to resolve once the security has been provided (Newnham et al., 2019; Nickerson et al., 2011; Silove et al., 2007). The findings identified here have parallels to those reported by Patel and Colleagues (Patel et al., 2016) study that future threats can cause excessive anxiety and may negatively impact executive function. This corresponds with a growing body of evidence showing similar processes associated with past and future self-referential memory, which are both adversely affected by PTSD symptoms (Brown et al., 2014; Johnson et al., 1988; R. J. McNally et al., 1995; Rubin, 2014). We did not find this directly linked to the future threat but to the first life narrative provocation task irrespective of past or prospective focus. There was evidence of partial regain in verbal fluency functioning during the second provocation task reflected in the quadratic growth response pattern.

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outcomes for Refugees and asylum seekers indicate that secure residency and social support in host countries can promote wellbeing. This study supports the literature that there is an association that may be most pronounced for *cluster B* intrusive symptoms (Unwanted upsetting memories, Nightmares, Flashbacks, Emotional distress after exposure to traumatic reminders, Physical reactivity after exposure to traumatic reminders), and *cluster E* arousal symptoms (Irritability or aggression, Risky or destructive behaviour, Hypervigilance, Heightened startle reaction, Difficulty concentrating and Difficulty sleeping). It also was shown that there was an association between Verbal Fluency amount (total correct recalled words), strategy (number of clusters) and success (cluster size) and symptoms of posttraumatic stress and Future Threat amongst Farsi-speaking refugees and asylum seekers. After adjusting for current PTSD symptoms, the future threat symptoms showed no other association. It suggests that in addition to a high level of distress, asylum seekers also experience reduced cognitive capacity that may further increase their vulnerable status. This suggestion is most closely associated with ongoing intrusion and arousal symptoms.

5. Limitations

In interpreting these results, fundamental limitations need to be considered. First, this research was undertaken concerning Farsi and Dari-Speaking refugees and asylum seekers within a particular immigration context in Australia, and findings may not be generalisable to other groups or different resettlement settings. Second, although PTSD and FFT groups had PTSD scores that placed them within the PTSD cut-off, we did not include a formal diagnosis of the participants and relied on self-report measures. Third, this study was carried out over the cause of the COVID pandemic, and interviews had to be suspended following the outset of the outbreak resulting in a 2-year delay before the final group of interviews would be undertaken. This condition may have impacted the response of later participants who were two years further into their stay in Australia. It is also important to note that we could not fully recruit all of the intended PTSD-only group, with many participants in the more extensive study still facing uncertainty about their future. In addition, many have been granted Temporary Refugee Protection leading to reporting some FFT symptoms. Forth, we acknowledge that only some of the *a priori* hypotheses were supported. Some key differences were identified through post hoc observation of the findings, which is inconsistent with a hypothesis-driven methodology. We acknowledge this weakness but have reported these findings because of their potential significance to the field. Therefore, the results must be subject to independent replication with *a priori* hypotheses specification.

Interestingly, the FFT group contained the highest ratio of asylum seekers (71%), with the PTSD group comprising around 50% of asylum seekers and the low symptom group 30%. However, the groups were formed based on symptom criteria. This ratio is consistent with previous research showing higher PTSD symptoms among asylum seekers (Iversen et al., 2010; Z. Steel et al., 1999). By the time of this study, most asylum applications in the cohort included had been resolved with those remaining having been rejected and under review or where the application remained suspended due to security concerns. In all instances, the asylum seeker group had a greater risk than other participants of being subject to future removal and repatriation procedures. It also confirms that the higher representation of asylum seekers in the group reporting distressing future-focused threat intrusions suggests a link between future-focused intrusive symptoms and objective future threats. This observation is consistent with adaptive evolutionary models of PTSD (Silove, 1998) and the warning signalling hypothesis proposed by Ehlers and Colleagues regarding the functional nature of threat intrusions (Ehlers et al., 2002).

There were two groups formed on the basis of the order in that the interview was performed (those who completed the future first and those who completed the past first). A significant difference in symptoms displayed by these two groups was observed. In addition, the participants who completed the first future interviews had a higher percentage of PTS symptoms than the two other groups, which was meaningful. Although the FTT group presented better verbal productivity (than PTS), this difference was insignificant. The FTT symptom group presented similar results to the low symptoms group, showing a negligible difference in verbal fluency level to those with common symptoms (Table 2). It was hypothesised that the FTT and PTS groups would demonstrate greater impairments in executive function and verbal productivity. According to the result, this hypothesis was only partially supported. The impact of PTS on Letter Fluency and Category Fluency was shown by Shandera- Ochsner (Shandera-Ochsner et al., 2013).

Limitations associated with reliance on the category fluency as a single measure of executive function need to be acknowledge. Category fluency is related to a wide range of cognitive domains, not just executive functioning (Faber et al., 2022), such that confirmation of our findings with alternative and specific measures of executive functioning should be undertaken to ensure the reproducibility of the findings across a range of measures of executive functioning. For instance, it is possible that low scores on the CFT reflected slow processing speed, rather than deficits of executive functioning per se (Kavé et al., 2011). Inclusion of a specific measure of processing speed would potentially have allowed us to derive a more specific estimate of executive functioning if processing speed could have been controlled for.

Finally, the selected participants include a small sample of Farsi speaking of refugees, asylum seekers and migrants in one host western country, Australia. Accordingly, the finding of VF performance based on demographic categories may vary from the immigrant population in Australia or in all other countries.

6. Conclusion

We examined the impact of posttraumatic stress symptom intrusions on measures of executive functioning amongst refugees and asylum seekers at rest and following a trauma provocation procedure. A unique feature of the study was the separation of PTSD into those with and those without prominent future-focused threat. While both groups had evidence of reduced executive functioning this manifested differently for the two groups examined. The PTSD group had consistently low verbal fluency functioning across all time points compared to a low symptom group but contrary to predictions did not display additional deterioration following the provocation task. The group with prominent future-focused threat intrusive symptoms displayed comparable levels of verbal function to the low symptom group at baseline which was unexpected given the comparable level of PTSD reported. Following the trauma narrative there was a marked loss of functioning that was not present for the low symptom group. This finding if confirmed by future research has important theoretical and practical implications. At a theoretical level the findings suggest that a subset of those reporting high PTSD symptoms may in fact be displaying a functionally adaptive response to objective threat, in the case threat associated with insecure residency and risk of repatriation with close to three quarters of this being asylum seekers. This is not easily reconcilable with traditional models of PTSD that conceptualises manifestation of symptoms as evidence of harmful dysfunction. Within a translational context asylum seekers with PTSD like symptoms may face particular difficulty in presenting their claims to decision makers if the discussion leads to a threat related cues. Under such circumstances the current research would predict a loss in functional capacity that may impact capacity.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.psycom.2023.100146.

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