

# Circadian influence on intrusive re-experiencing in trauma survivors' daily lives

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## BACKGROUND

The core clinical feature of posttraumatic stress disorder (PTSD) is recurrent re-experiencing in form of intrusive memories<sup>1</sup>. While a great number of biological processes are regulated by sleep and internal biological clocks<sup>2,3</sup>, the effect of 24-hour biological cycles, named circadian rhythms, has not been investigated. Here we examined effects of time of day on frequency and characteristics of intrusive re-experiencing in trauma survivors (N = 50) with and without PTSD. We investigated (i) time-of-day dependent effects on frequency and distribution of intrusive re-experiencing in the overall sample as well as in PTSD versus Non-PTSD and (ii) time-of-day dependent effects on the memory characteristics intrusiveness, vividness, nowness and fear.

## METHODS

The sample, obtained from a prior investigation, consisted of 50 survivors of assault or road traffic accidents (RTA) that had been recruited for a study<sup>4</sup> capturing intrusive re-experiencing by using ecological momentary assessment (EMA)<sup>5</sup>. Intrusive memories were defined as memories of the trauma that popped to mind involuntarily<sup>6</sup>. Intrusive memories were assessed with electronic diaries that allowed for detailed assessment of time of occurrence and content: all entries were timestamped. Further, characteristics of intrusive memories, such as "intrusiveness", "nowness", "vividness" and "fear" were rated by participants on a scale from 0 to 100. According to the reported symptoms in the CAPS<sup>7</sup> the sample was divided into a PTSD group (n = 21) and a non-PTSD group (n = 29). Participants with PTSD did not significantly differ from those without PTSD on any of the sociodemographic variables (p > 0.05), except on alcohol consumption. However, logistic multilevel regressions did not indicate any moderation on the effect of time by alcohol on intrusive memory frequency (Z = -1.48, p = 0.14).



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## RESULTS

The effect of time on intrusions was investigated by descriptive statistics, visualizations (lomb-scargle periodograms) and logistic multilevel poisson regressions in R version 3.5.1. (see table 1). Intrusive memory frequency and their characteristics were significantly higher in participants with PTSD compared to those without PTSD and significant differences between the daily temporal patterns of intrusion frequency were present when comparing these two groups. Both sum and mean score distributions for participants with PTSD showed a heightened constant level of intrusive re-experiencing in the afternoon and the evening, whereas a descending slope was present in non-PTSD participants. Furthermore, the time of highest frequency for intrusive memories was shifted towards the morning in the PTSD group (see figure 1).

Table 1. Logistic Poisson multilevel regressions

a. Regression model predicting the number of intrusive memories based on time of day (random effect = Individuals)					
Group	Beta	Sd.error	Z-value	Rand.effect	p-Value
Non-PTSD	-0.046	0.013	-3.676	0.192	<0.001
PTSD	-0.035	0.013	-2.757	0.273	<0.001

b. Regression model predicting the relationship between single characteristics and time of day (random effect = Individuals). PTSD diagnosis interaction was controlled for (interaction) in the model and removed if the interaction was non-significant.							
Predicted	Interaction	Predictor	Beta	Sd.error	df	t-Value	p-Value
Intrusiveness	No	Time of day	-0.536	0.231	372	-2.323	0.02*
Vividness	No		0.286	0.247	362	1.157	0.248
Nowness	No		0.295	0.247	362	1.183	0.237
Fear	No		0.134	0.28	351	0.48	0.63

Figure 1. Intrusion Frequency and Characteristics across the day

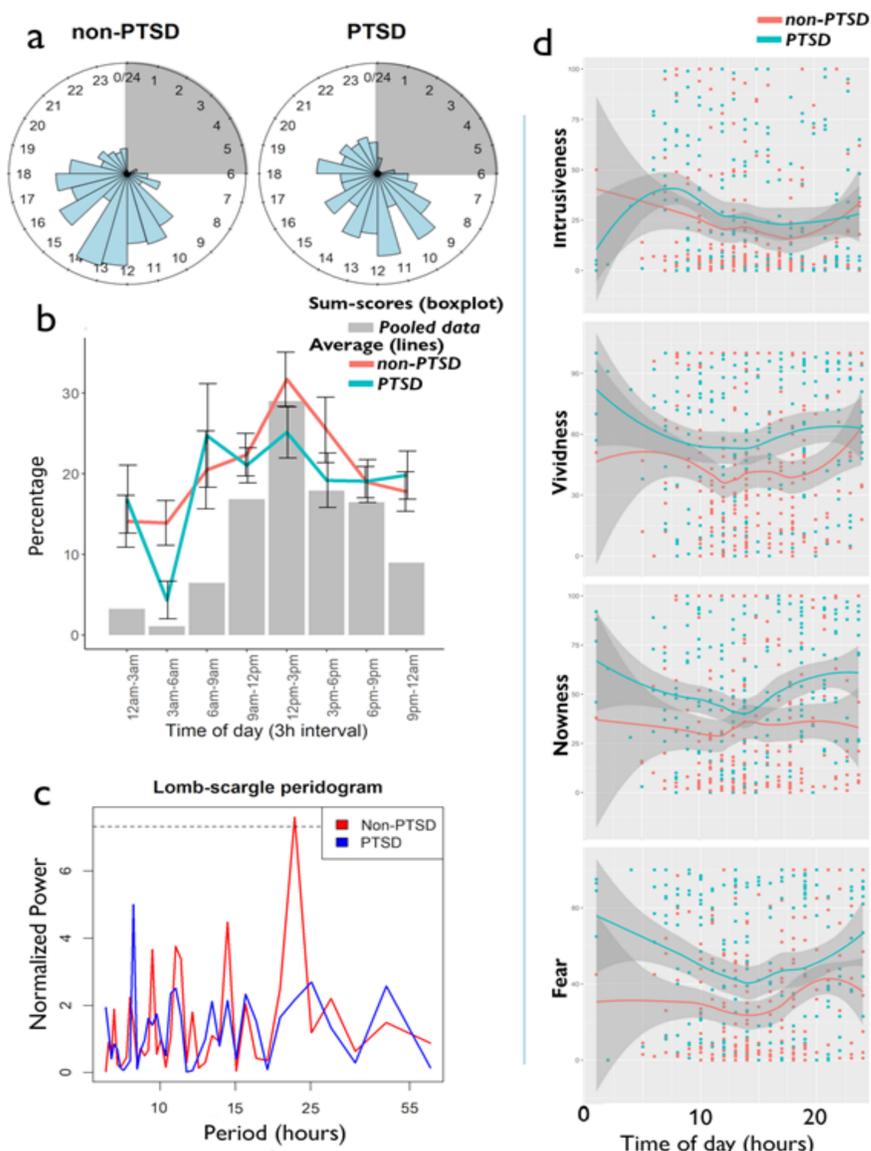


Figure 1. a. Density plot (sum-scores) for non-PTSD (left) and PTSD participants (right) across the day ( $\chi^2 = 175.56, p = 0.03$ ). b. Average distribution (non-PTSD vs PTSD) vs sum-scores comparison. 3-hour bins were chosen for the representation in order to avoid overloading the figure. Average and sum-scores to the same scale, the percentage of events calculated. c. Lomb-Scargle power-spectrum performed to create the discrete spectrum representation of our periodic signal. Normalized power is the result obtained from the Fourier transform of its auto-correlation signal. d. Non-linear regression for Intrusiveness, Vividness, Nowness and Fear.

## DISCUSSION

Intrusive memories showed a curvilinear pattern that peaked at 2pm. Intrusive memories in the PTSD group showed a constant level of intrusive re-experiencing in the afternoon and evening, whereas a descending slope was present in the non-PTSD group. In PTSD, intrusive memories might thus be experienced in a more time-scattered fashion throughout the day, indicating chronodisruption. Intrusion characteristics did not follow this pattern and displayed a trend towards an inverted pattern. Although preliminary and based on a small sample size, these findings contribute to a better understanding of the everyday occurrence and characteristics of intrusive memories and point to the added value of examining its time-dependent effects, which can directly inform prevention and intervention science.

## REFERENCES

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