

Published online: 12-13-2018

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Recommended Citation

Van Wijk, Charles H. (2018) "Coping During Conventional Submarine Missions: Evidence of a Third Quarter Phenomenon?," *Journal of Human Performance in Extreme Environments*: Vol. 14 : Iss. 1 , Article 12.

DOI: 10.7771/2327-2937.1108

Available at: <https://docs.lib.purdue.edu/jhpee/vol14/iss1/12>

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Coping During Conventional Submarine Missions: Evidence of a Third Quarter Phenomenon?

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Abstract

The third quarter phenomenon refers to the decline in performance during the third quarter of missions in isolated, confined, and extreme environments, regardless of actual mission duration. This can be observed through changes in cognitive and interpersonal behavior, and an increase in reported negative experiences and undesirable mood states. This effect has been studied in polar and space missions, but there are no available reports on it during submarine missions. This study provides an additional analysis of previously published data that were collected during a conventional submarine patrol mission, to consider whether a stage-model of adaptation (in particular a third quarter effect) could be observed. It used data on coping—specifically the self-reported endorsement of coping activities during a submarine deployment—to achieve this. While the data could be interpreted as supporting a third quarter effect, they also reflected a general decline in individual well-being across mission duration. However, the decline was relatively small in real terms, and may not reflect meaningful changes in affect or performance. Practically, this could be useful for optimizing coping across mission duration, through enabling realistic preparation and developing mission-specific interventions.

Keywords: coping, stage-model of adaptation, submarines, third quarter effect

Introduction

There are studies that support a hypothesis that decreases in performance under isolated, confined, and extreme (ICE) environmental conditions occur in stages (Sandal, Vaernes, Bergan, Warncke, & Ursin, 1996). For example, a cluster of symptoms has been described as the winter-over syndrome, consisting of sleep disturbance, impaired cognition, negative affect, and interpersonal tension and conflict experienced by people on polar expeditions in the Antarctic (Palinkas & Suedfeld, 2008). The symptoms appear to increase after the midpoint of an expedition and are reduced toward the end of the expedition (Palinkas & Houseal, 2000; Palinkas et al., 2007; Reed et al., 2001).

This pattern was first highlighted by Bechtel and Berning (1991) who described the “third quarter phenomenon” in which performance is likely to decline during the third quarter of a mission in ICE environments, regardless of the total duration of the mission itself. Support was found in the analysis of data from polar missions that indicated more negative experiences during the third quarter of isolation and confinement in polar stations and expeditions, regardless of mission duration (Palinkas, Gunderson, Johnson, & Holland, 2000; Sandal, 2000; Stuster, Bachelard, & Suedfeld, 2000).

This phenomenon is considered as much psychosocial as environmental in nature and is independent of mission duration. It is hypothesized to result from the realization that a mission is only half completed and that a period of isolation and confinement equal in length to the first half remains. For example, elevation in mood scores remain relatively constant throughout the second half (i.e., third and fourth quarters) of a mission (Palinkas, 2003, p. 356). In summary, the phenomenon refers to changes in (1) cognitive and (2) interpersonal behavior, and (3) an increase in reported negative experiences and (4) undesirable mood states (Palinkas & Suedfeld, 2008; Sandal, 2000; Stuster et al., 2000).

In space programs, changes in behavior and performance shortly after the halfway point of missions, regardless of duration, and indicative of the third-quarter phenomenon, have been found in anecdotal reports of astronauts (Connors, Harrison, & Akins, 1985; Kanas, Weiss, & Marmar, 1996), although more recent analyses of data from space program studies reported no significant third quarter decrements in behavior and performance during long-duration missions in space or analogous settings (Belavy et al., 2013; Kanas, 2015; Manzey & Lorenz, 1998; Palinkas & Houseal, 2000; Palinkas, Suedfeld, & Steel, 1995; Sandal, Leon, & Palinkas, 2007).

Recent literature reviews (e.g., Wilson, 2011) suggested that the “third-quarter phenomenon” proposed by Bechtel and Berning (1991) may be less specific than initially thought. It appears that in situations of fixed-term isolation and stress, a period of discomfort often occurs during the second half of the stay, and while this is often confined to the third quarter of the stay, it may persist into the final quarter. As Bechtel and Berning (1991) initially suggested, it appears that the timing of

the phenomenon is not dependent on the total length of the isolation period. However, referring to a “third-quarter phenomenon” may be too limiting in its description when there is significant evidence to suggest that psychological changes may reveal themselves in terms of halves rather than quarters (Palinkas et al., 2000).

Notwithstanding earlier references to (nuclear) submarines in discussions of ICE environments, no specific reports could be found that examined any third quarter phenomenon among submariners (although there are indirect references to work with the first USN nuclear submarines; cf. Earls, 1969; Rohrer, 1961).

Thus, there is some evidence of a third quarter effect in polar missions (although not unanimous), no conclusive evidence of this in space missions, and no known available studies on submarines. Sandal et al. (1996) suggested that a stage-model of adaptation is probably more relevant for groups undergoing prolonged confinement in which boredom and monotony are prominent stressors, a situation that may be particularly germane to submariners.

Background of Data

A recent study reported on coping during a fixed-duration, operational deployment of a conventional submarine (Van Wijk, 2017). The current paper reports on an additional analysis of the data of that original study, to consider whether a third quarter effect could be observed. The original data focused on coping only, and were used in the current analysis with the assumption that any negative time-period effect would be associated with lower personal resources or resilience, and therefore be visible in coping dynamics.

The original study and data are described elsewhere (Van Wijk, 2017). In brief, the study took place in a conventional diesel–electric submarine (Type 209), where participating submariners ($N = 30$, mean age = 33.6 years, 23% women) completed a modified Brief COPE scale every fourth day during a 23-day operational patrol, with the aim to investigate temporal changes in coping strategies over the course of the mission. The Brief COPE scale is a 28-item self-report inventory designed to assess a broad range of coping responses across 14 coping domains (Carver, 1997). Higher scores represent greater endorsement of coping strategies. In this study a modified 24-item version was used, which discarded two domains deemed inappropriate for the study context (i.e., substance abuse and self-blame).

Amongst others, the study reported that coping strategy profiles remained relatively consistent across time points, although the degree of endorsement of coping responses decreased. In other words, coping *styles* appeared stable across time, but participants reported fewer actual coping *activities* at certain time points.

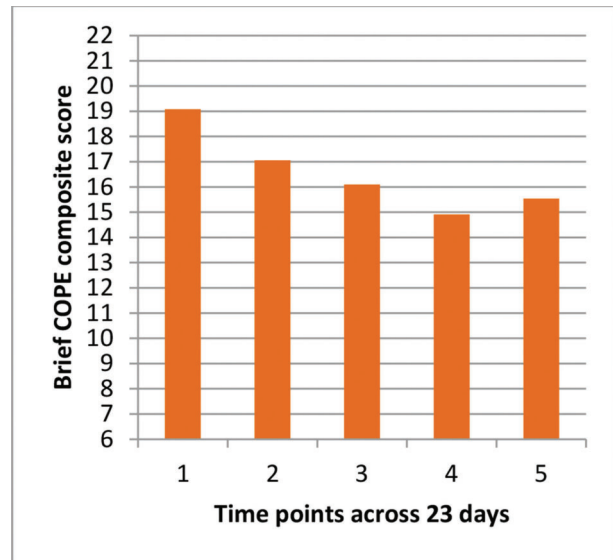


Figure 1. Composite score (i.e., total of means) of the mod-BC-scale across five time points.

Additional Analysis of Data

The data from the original study (endorsement of coping responses across five time points) were used to develop a graph of composite scores. This was done by summing the total mean scores of the Brief COPE per time point across mission duration. It needs to be cautioned that the scale was not originally designed to be used in such a way, and the results of this calculation are at best suggestive.

The composite scores, presented in Figure 1, suggest something reminiscent of a third quarter effect, with the lowest point of coping reported during the third quarter. In this regard, the graph appears consistent with a third quarter phenomenon, if it is *assumed* that changes in the endorsement of coping strategies are associated with lower resilience or personal psychological resources during that time period. However, the graph also indicates progressively less endorsement of coping responses over the full duration of the mission, and although it reached its lowest level in the third quarter, rather suggests a general decline in reported coping activity.

The graph has a number of limitations. The scale was not originally designed to use composite scores, and neither was the original data collection aimed at investigating a specific stage-model of adaptation. The graph as visual presentation is simply a *post hoc* observation of data. Further, the scale of the graph may be somewhat deceptive, as the actual changes between time-points are quite small. Lastly, interpretation of a stage-effect was based on the assumption that changes in coping would reflect changes in personal resources or resilience (traditionally measured by mood states or similar mechanisms).

Conclusion

Changes in performance across the stages of missions in ICE environments have typically been reported as being visible in a cluster of affective and cognitive symptoms (e.g., sleep disturbance, impaired cognition, negative affect) and/or behavioral signs (e.g., interpersonal tension and conflict). This report used data on coping—specifically the self-reported endorsement of coping activities during a submarine deployment—to consider whether a third quarter effect could be observed. Although the data could be interpreted as supporting such a hypothesis, they more likely indicate a general decline in individual well-being across the entire duration of the mission. It is noteworthy that the decline was relatively small in real terms and may thus not reflect meaningful changes in affect or performance.

Practically, this analysis could be useful for optimizing coping across mission duration, achieved by firstly enabling realistic preparation, and secondly developing mission-specific interventions.

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