

# A LONGITUDINAL ASSESSMENT OF PSYCHOLOGICAL ADAPTATION DURING A WINTER-OVER IN ANTARCTICA

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**ABSTRACT:** The seasonal variations of psychological reactions in isolated and confined environments have been studied and theorized in terms of *third-quarter phenomenon*; the third quarter of the isolation period is the moment when the most discomfort is reported by the winterers. Referring to Rivolier's comparative study, this article examines the manifestations of the third-quarter phenomenon by analyzing the data collected with an observation grid completed by the mission's doctor. The stress reactions of 27 winterers are observed during a 50-week period. The results show that the third-quarter phenomenon does not appear after the middle of the stay but more precisely after the middle of the isolation period. Changes in moods and personal reactions are reported but also in social and physical reactions. The results are discussed in terms of externalization of stress reactions, and the influence of the data collection method emphasized.

**Keywords:** *adaptation; stress reactions; diachrony; ICE (isolated and confined environments)*

**Antarctica has long been viewed** as a natural laboratory for studying the stresses on health and human performance associated with isolation in an

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**AUTHOR'S NOTE:** *This research is part of an international project coordinated by the Scientific Committee for Antarctic Research. Its method was presented during the July 1998 Congress by Pr. J. Rivolier to the Human Biology and Medicine Group. Most of the countries decided to collaborate with the French and three of them have already started conducting the same protocol.*

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extreme environment (Gunderson, 1963). The polar environment is described as being extreme because survival is impossible for the unprotected and ill-provisioned individual. It is unusual because it is much different from the accustomed physical environment of any other part of the inhabited globe and stressful because the natural environment is dangerous and difficult to access (Taylor, 1987). Antarctica is the most isolated of the Earth's continents, especially during the austral winter when travel and communications between the continent and the outside world are restricted.

Nevertheless, the physical characteristics of the polar environment are not the strongest stressors that may be encountered by individuals in Antarctica. Psychological aspects bring about more difficulties for people who live there. Three main factors are described by the winterers as being difficult with which to cope:

1. **Isolation:** Prolonged isolation implies separation from family and friends for all members of the expedition (Zuniga, 1962). Loneliness, lack of social and affective relations, and loss of usual social rules are the principal consequences of this isolation (Taylor & Brown, 1994). This isolation can be moderated by the satellite phone connections, but it remains very expensive and sometimes restricted. Winterers have access to the World Wide Web or e-mail at some stations but not in the French ones.
2. **Confinement:** In such a situation, confinement should be distinguished from crowding. Confinement in isolated small groups implies a lack of privacy. The presence of others within this crowded space brings about social conflicts (Stokols, 1976). In the French Dumont-d'Urville Station, every winterer has a private room at one's disposal, but it is very small. The rest of the building is quite spacious, but it is impossible to leave and go outside alone. This is the most important cause of frustration for the winterers.
3. **Occupation:** This factor concerns individual and group work, leisure activities, and participation in collective tasks. All of these activities have to be carried out with the restraints of the environment. Moreover, the winterers have to deal with periods of underoccupation, by comparison with the anterior life, and periods characterized by high levels of workload (Rivolier, 1979). During the winter, leisure may be an efficient way of adjusting to the extreme conditions, but it may also be seen by some winterers as a source of frustration because activities are limited.

As a consequence of the exposure to these stress factors, stress reactions are expected to appear for everybody. For most of the winterers, the frequency and the intensity of the reactions remain low, but others could experience adaptation difficulties that sometimes generate substantial discomfort and have important consequences on the other group members. A number of

studies have revealed that stress in extreme conditions, such as periods spent in polar environments, is often noticeable given a common set of symptoms (Gunderson, 1974; Nardini, Herrmann, & Rasmussen, 1962; Strange & Klein, 1973). Natani and Shurley (1974) observed that several symptoms were visible in every group of polar winterers. The most frequent were insomnia, irritability, headaches, anxiety, feelings of depression, lack of motivation, concentration difficulties, and sore muscles. According to Rivolier (1989), psychopathological reactions such as schizophreniform troubles, psychasthenic-obsessional, or paranoid reactions are very rarely reported (by less than 2% of the winterers; in 2001, Cazes & Bachelard confirmed this percentage in an unpublished French report). Although very rare, these reactions are severe enough to have repercussions on the entire group and on the achievement of the mission. That is why the study of the psychological adaptation of the winterers has great relevance.

Several classifications of stress reactions and maladjustment manifestations in Antarctica have been proposed to facilitate their prevention. Strange and Klein (1973) revealed clusters of symptoms that were described in terms of depression, hostility, sleeping difficulties, and a decrease in cognitive efficiency. Within each of these clusters, psychological and physiological symptoms are associated with one another. Referring to Gunderson's (1966) classification (stability, compatibility, and ability) and to Rivolier (1974), Cazes, Rivolier, Taylor, and McCormick (1989) proposed that the psychological adaptation should be observed through four categories: the thymic reactions (mood variations, anxiety, etc.), the social reactions (aggressivity, withdrawal within oneself, etc.), the somatic reactions (sleep disturbances, functional symptoms, etc.), and the occupational reactions (overinvestment in work, lack of interest for leisure activities, etc.).

This four-factor classification is actually the most recent and the most complete that has been proposed to describe the winterers' reactions. The Adaptability Questionnaire (ADQ) proposed by Cazes et al. (1989) to study psychological adaptation is based on these four categories.

Rivolier (1992) named the difficulties encountered by the polar workers winter-over mental syndrome. This syndrome is described as a useful mechanism of adaptation and generally progresses through three stages. At Stage 1, the alarm stage, the participant generally wonders why he or she really decided to winter-over. He or she thinks he or she will not be able to cope with the extreme conditions and wants to go back to his or her mother country. At Stage 2, the resistance stage, the participant tries to protect himself or herself by engaging in contests or disputes with other group members. Instead of being aggressive, the winterers may sometimes become depressed and with-

drawn. Finally, during the exhaustion stage, the participant admits his or her inability to change the environmental and psychological conditions.

Recently, Cazes and Bachelard (2001) reported compensation between physical symptoms and the hostility that appears in interpersonal relations. However, Mocellin and Suedfeld (1991) conclude that the polar experience was not generally aversive and stressful. Most of the time, the stress reactions and the behavioral responses of the winterers are useful, as suggested by Palinkas (1992), who described long-term positive effects of wintering-over. Most of the reactions are not the expression of an inability to cope with stressors and should be considered as the normal reactions of the winterers. Décamps (2003) proposed to name the different regroupings of stress reactions that appear during the winter-over the *adaptive reactions*. Moreover, the adaptive reactions should be distinguished from coping strategies: It has been stated (Décamps, 2003) that some of these reactions, such as depressive reactions, cannot be considered as strategies that are used by the winterers to modify the environmental stressors because they sometimes generate a substantial mental discomfort.

Taking the possibility of a seasonal influence into account, several authors studied the diachrony of such regroupings of psychological symptoms. They reported various results that are sometimes contradictory. According to Gunderson (1968), the number of the stress reactions tends to increase during the course of the winter-over. Palinkas, Cravalho, and Browner (1995) reported seasonal variations of depressive symptoms. Rohrer (1961) observed that winterers were anxious at the beginning of the stay, and this lasted for approximately 2 months. Then they became depressed, showing somatic symptoms and sleep problems. By the end of the period, they became agitated. Mocellin and Suedfeld (1991) showed that arousal and tension were high during the trip from home to port to the polar base and just before the end of the stay.

According to several authors (Palinkas et al., 1995; Palmi, 1963; Rohrer, 1961), it can be stated that the third quarter of the exposure to an extreme environment is the period when most participants will report the most discomfort. Bechtel and Berning (1991), who observed the presence of a decrease in the winterers' moods just after the middle of the isolation period, named this reaction the *third-quarter phenomenon*. Sandal (2000) confirmed this finding by observing a decrease of well-being and optimism in the second half of the stay. She also reported an increase of aggressive behaviors and observed that this phenomenon may influence coping strategies. Steel (2001) observed a decrease of arousal and an increase of displeasure during the third quarter of the mission. Sandal, Vaernes, and Ursin (1995) observed the presence of the third-quarter phenomenon in an analogue environment: A simu-

lated space mission and Stuster, Bachelard, and Suedfeld (2000) noted its presence during short-duration polar missions.

However, although this phenomenon has received a fair amount of attention, there has been a limited number of studies to support its existence. Moreover, several studies did not confirm its supposed presence: Neither Lugg (1977) nor Williams (1989) noted such a trend in the groups they studied. Palinkas and Houseal (2000) found no concordance when studying the seasonal variations of the winterers' moods and behaviors in three different Antarctic stations. Kanas et al. (2001) found no difference in space mission crew members' interpersonal functioning between the first and the second part of the mission.

The variety of these results addresses several questions, notably those of the procedures and methods that were conducted to study the phenomenon. First, the authors sometimes focused on different ways of adjusting (stress reactions, coping, psychopathological reactions, etc.), even if most of the studies generally concern the winterers' moods and feelings. In these studies, differences can also be observed concerning the moment of the data collection. This factor has been studied by Steel (2001) with a comparison of two different methods based on the self-evaluations of the winterers: (a) mood scales completed monthly during their stay and (b) retrospective measures of each month at the end of the stay. Although the third-quarter phenomenon has been confirmed within these two methods, the regular measures seem to describe more precisely the diachrony of such a phenomenon. Other studies paid special attention to the nature of the data that were analyzed; Stuster et al. (2000) observed the presence of the third-quarter phenomenon by analyzing the content of personal diaries maintained for the study by winterers (but no comparison with other types of data).

Generally, all the data that are collected in these studies correspond to the self-evaluations of the winterers. This is the most important limitation to support the existence of the third-quarter phenomenon because this method has been considered as generating several biases in the data, biases that could explain the noncongruence of the results; Rivolier (1981), with a methodological comparison of different sources of information during the International Biomedical Expedition in Antarctica, showed that self-evaluation questionnaires were the least valid method when evaluating psychological adaptation in isolated and confined groups because winterers are apparently too indulgent when describing the quality of their adaptation, by comparison with other sources of information, such as the observations of a trained observer or the reports provided by the other group members concerning their teammates' adaptation. These two last methods were highly correlated.

Another comparison (Sandal, 2001) stated that peer-ranking questionnaires confirmed video recordings of the communication between the crew members of a space mission simulation. This article also stated that post mission interviews are very useful because they provide a description of the diachrony based on qualitative information. However, they should not be the only data collection method.

All of these methods and the findings that were reported allow us to consider more precisely the seasonal variations of adaptation in Antarctica. Peer-ranking questionnaires seem to be a useful and reliable method to study the winterers' adaptation. Other methods, such as rating scales or observation grids, should probably be of great interest but have apparently never been tested.

The object of this research article is to study the evolution of the different categories of stress reactions during a winter-over by analyzing data collected with an observation grid.

Because Bechtel and Berning (1991) described the third-quarter phenomenon in terms of variations in the winterers' moods, we make the assumption that changes may appear in the winterers' personal reactions after the middle of the stay. Moreover, changes should also be observed concerning the social, physical, and occupational reactions, referring to the different categories of the Cazes et al. (1989) classification.

## METHOD

The method requires the use of a 59-item observation grid by the mission's doctor every week. The grid lists the stress reactions that may be presented during the course of the winter-over. These reactions correspond to the physical and psychological symptoms that have already been observed or reported during previous studies of psychological adaptation in isolated and confined environments conducted until 1996 (scientific papers, reports of the winterers, doctors' observations, etc.). The 59 stress reactions are divided into the four categories of the classification proposed by Cazes et al. (1989) in the ADQ: the thymic reactions (Category V1, 19 items), the social reactions (Category V2, 13 items), the somatic reactions (Category V3, 17 items), and the occupational reactions (Category V4, 10 items). The list of the grid's stress reactions is presented in Appendix A.

The psychometric qualities of the grid are very satisfactory (Décamps, 2003). The interitem reliability of the four categories of stress reactions has been calculated with Cronbach's alphas: for personal reactions,  $\alpha = .7180$ ;

for the social relations,  $\alpha = .8546$ ; for the physical reactions,  $\alpha = .5784$ ; and for the occupational reactions,  $\alpha = .7563$ . The interrater reliability has been calculated between two observers who completed the grid independently. The fidelity coefficient is higher than 92%.

From a qualitative point of view, the use of the grid is relevant to assess the usual reactions of the winterers (contrary to specific instruments such as depression questionnaires, the indication of which is the evaluation of the intensity of pathological reactions). These stress reactions are liable to be presented by every winterer and should not be considered as maladjustment manifestations: They generally appear consequent to the confrontation to any stressful environment. However, an important number of stress reactions are generally reported for the winterers who present adaptation difficulties.

For this research, 27 winterers were observed between December 1997 and December 1998 at the Dumont-d'Urville station in Adelie Land, Antarctica. This station is based on the coast of the Dumont-d'Urville Sea and faces Tasmania. The average age of the winterers was 29 years and 7 months (range = 21 to 59 years). Most of them (17) were staying in Antarctica for the first time. Of the remainder, 4 of them already wintered once, 4 twice, and 2 three times.

Access to the station is only possible by boat between the end of November and the beginning of March. During this period, it is still possible for the winterer to leave the station if he or she thinks he or she will not be able to stay for an entire year. Consequently, the real isolation period begins with the departure of the last boat at the beginning of March and lasts approximately for 9 months.

Between the arrival of the winterers (from the end of November 1997) and their departure (before the end of December 1998), the mission's doctor filled the grid 50 times (that correspond to 50 one-week periods). Each week, he noted the presence or the absence of each of the stress reactions for each of the winterers. To fill out the grid, he had to refer to his observations and also the systematic consultations that took place four times a year. Telephone calls regularly took place (approximately every 2 months) between the doctor and one of the authors to insure that no problems occurred when following the protocol. Moreover, a special training program was provided to the doctor before his departure so that he could fill out the grid and act as a participating observer in the group.

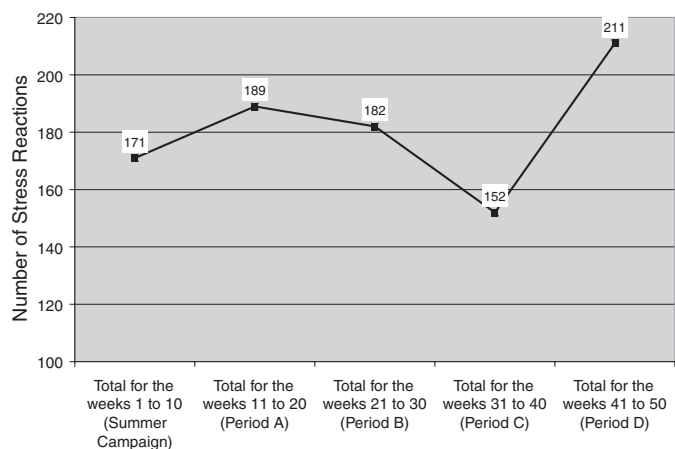
In the French stations, the mission's chief generally contributes to the evaluation of the adaptation of the winterers. However, for economical reasons, this function is sometimes provided by another winterer, such as the chief of one of the research programs or sometimes the doctor. This last case occurred for the mission we studied. Consequently, the data were collected

by one observer only. However, this remains a valid method of evaluation of psychological adaptation, according to Rivolier (1981). Its comparative study showed, on one hand, that adaptation difficulties tend to be underestimated when the data are collected with self-evaluation questionnaires by comparison with peer-ranking questionnaires or the doctor's observations and, on the other hand, that the data collected with these two last methods are highly correlated (Rivolier, 1981). More generally, in such a situation, the presence of several observers, such as the use of peer-ranking questionnaires, is generally a source of tension in the group, according to Rivolier (1989).

To test the hypothesis concerning the changes that are supposed to take place after the middle of the isolation period, the whole duration of the winter-over was divided into several periods. The first 10 weeks (1 to 10) of observation corresponded to the summer campaign (SC). The 40 following weeks of observation corresponded to the isolation period of the winter-over. These 40 weeks were divided into four 10-week periods: Weeks 11 to 20 (Period A), 21 to 30 (Period B), 31 to 40 (Period C), and 41 to 50 (Period D). The summer campaign was not taken into account for the study of the third-quarter phenomenon. Consequently, the middle of the isolation period corresponded to the end of Period B and the beginning of Period C. The total number of stress reactions presented by all the winterers was reported for each of the five periods: SC, A, B, C, and D. To study the evolution of personal, social, physical, and occupational reactions, the number of stress reactions observed by the doctor for each of these four categories and for all the winterers during the different periods of the winter-over were reported. The limited number of winterers (27) required the use of a nonparametric test. Consequently, the scores differences between the different periods were tested with Wilcoxon's *Z* test.

According to Bechtel and Berning (1991), who described the third quarter of the mission as the period when the most discomfort is reported, Hypothesis 1—that the third-quarter phenomenon should be observed just after the middle of the isolation period by an increase of the total number of stress reactions—was tested. This increase should at least be observed for the number of thymic reactions because Bechtel and Berning (1991) reported a decrease of the winterers' moods (Hypothesis 2). According to Sandal (2001), who reported an increase of aggressive behaviors, an increase of the number of social reactions should also be observed (Hypothesis 3). Finally, according to Cazes and Bachelard (2001), this increase is supposed to be complemented by a decrease of the number of somatic reactions (Hypothesis 4).





**Figure 1: Evolution of the Total Number of Stress Reactions**

**TABLE 1**  
Levels of Significance of the Differences Observed in Figure 1

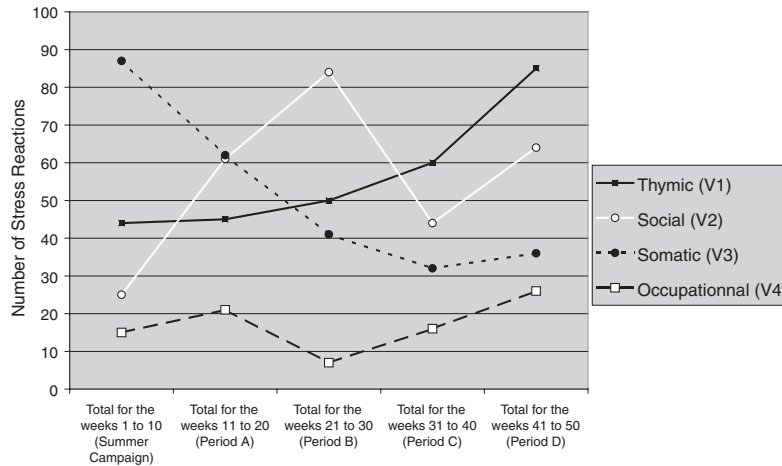
|                 | <i>Time Periods</i> |          |          |          |
|-----------------|---------------------|----------|----------|----------|
|                 | <i>A</i>            | <i>B</i> | <i>C</i> | <i>D</i> |
| Summer Campaign | NS                  | NS       | .05      | .01      |
| Period A        |                     | NS       | .01      | .05      |
| Period B        |                     |          | .01      | .01      |
| Period C        |                     |          |          | .01      |

**RESULTS**

The following figure (Figure 1) presents the evolution of the total number of stress reactions.

The significance of each of the differences observed on the figure is presented in the following table (Table 1).

The data presented in Figure 1 failed to support Hypothesis 1. The results confirmed the presence of a third-quarter phenomenon. However, its manifestation was observed by a significant decrease of the total number of stress reactions. No significant variation was observed from the SC to Period B.



**Figure 2: Evolution of the Four Categories of Manifestations During the Winter-Over**

The number of stress reactions significantly decreased at Period C. Then, a significant increase was observed during the Period D.

Figure 2 presents the evolution of each of the four categories of reactions.

The significance of each of the differences observed on the figure for the thymic (V1), social (V2), somatic (V3), and occupational (V4) reactions is presented in the following table (Table 2).

The results confirmed Hypothesis 2, concerning the increase of the thymic reactions (V1). These reactions were stable before the middle of the isolation period. Then a significant increase was observed at Period C and until the end of the stay. However, the results failed to support the third hypothesis. The social reactions (V2) generally increased significantly during the stay, although a significant decrease was reported for the period following the middle of the isolation, Period C. Furthermore, Hypothesis 4 was not confirmed by the data: A significant decrease of the number of somatic reactions was observed, but this decrease took place before the third quarter of the mission. Then the number of somatic reactions remained stable at Periods C and D. No significant variation of the number of occupational reactions (V4) were observed between the different periods.

**TABLE 2**  
**Levels of Significance of the Differences Observed in Figure 2**

| <i>Reaction</i>   | <i>Period</i>   | <i>Period A</i> | <i>Period B</i> | <i>Period C</i> | <i>Period D</i> |
|-------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Thymic (V1)       | Summer Campaign | NS              | NS              | .05             | .01             |
|                   | Period A        |                 | NS              | .05             | .01             |
|                   | Period B        |                 |                 | .05             | .01             |
|                   | Period C        |                 |                 |                 | .01             |
| Social (V2)       | Summer Campaign | .01             | .01             | .01             | .01             |
|                   | Period A        |                 | .01             | .05             | NS              |
|                   | Period B        |                 |                 | .01             | .01             |
|                   | Period C        |                 |                 |                 | .01             |
| Physical (V3)     | Summer Campaign | .01             | .01             | .01             | .01             |
|                   | Period A        |                 | .01             | .01             | .01             |
|                   | Period B        |                 |                 | NS              | NS              |
|                   | Period C        |                 |                 |                 | NS              |
| Occupational (V4) | Summer Campaign | NS              | NS              | NS              | NS              |
|                   | Period A        |                 | NS              | NS              | NS              |
|                   | Period B        |                 |                 | NS              | .05             |
|                   | Period C        |                 |                 |                 | NS              |

## DISCUSSION

These results allow us to specify the nature of the reactions that could be linked to the third-quarter phenomenon. This phenomenon seems to occur variously according to the different categories of stress reactions: an increase of the number of thymic reactions (V1), a decrease of the number of social reactions (V2), and a stabilization of the number of somatic reactions (V3). No link between the third-quarter phenomenon and the occupational reactions (V4) was established.

The increase of the thymic reactions (V1) corresponds to the findings of Bechtel and Berning (1991), who reported a decrease of the winterers' moods after the middle of the stay. The results also recall the winter-over mental syndrome proposed by Rivolier (1992). The presence of an important number of somatic reactions at the beginning of the stay (during the summer campaign) can be related to the alarm stage. The high number of social reactions before the middle of the stay can be linked with the resistance stage, when the winterers try to modify their environment by contesting or disputing with other group members. Furthermore, the progressive increase of the number of thymic reactions probably corresponds to the reactions of the exhaustion stage, when the winterer has to admit his or her inability to cope with stressors.

It is also interesting to note that the thymic reactions (V1) and the somatic reactions (V3) seem to have an opposite evolution: The lower the number of somatic reactions (V3), the higher the number of thymic reactions (V1). This statement allows us to consider that the thymic and somatic reactions complement each other such that somatic symptoms may have prevention properties for negative and depressive feelings and for variations in the winterers' moods. Further clinical and physiological studies are required to determine if they could be considered as substitutes for negative emotions. However, caution must be exercised when attempting to posit a relationship between the thymic and the somatic reactions. The presence of social reactions may be a factor when accounting for this observed relationship; the most important peak of social reactions appears during Period B, when both thymic and somatic reactions are quite low. Moreover, this period corresponds to the lower number of occupational reactions. The potential compensation between the categories (such as the compensation observed by Cazes & Bachelard, 2001) does not only concern two types of reactions but probably all four.

Nevertheless, this relationship merits further investigation. One possible avenue would be to examine the modalities of expression of the stress reactions. This consideration could explain why some of the reactions of the winterers can be noticed by the entire group and why others are more internalized. At first sight, the thymic reactions could be considered as internalized reactions, contrary to the social and the somatic reactions, which seem to be more externalized and consequently more easily noticeable by the doctor. The principal difference between these two types of stress reactions probably concerns the mental elaboration that may be associated with the presence of internalized reactions.

During the second part of the winter-over, the stress reactions seem to be less externalized than in the first part. Periods C and D are the periods with the highest proportion of thymic reactions among the total number of reactions. Even with a special training program, these reactions (such as lack of self-confidence, boredom, or excessive preoccupation) seem to be less easily observable by the doctor than the externalized reactions. When taking this into account, the decrease in the number of the observed reactions at Period C should be considered as a stress reactions internalization period more than a real decrease of the number of presented stress reactions. This statement also addresses the question of the evolution of the efficacy of the doctor when observing his or her teammates' stress reactions; the increase in the number of thymic reactions and, more generally, of the internalized reactions might be explained by an increase in the doctor's efficacy for detecting this sort of reaction when observing the winterers.

The results seem to indicate that the third-quarter phenomenon does not only have any influence on the number of stress reactions but also on its nature. This hypothesis will have to be tested by studying the evolution of the stress reactions after recoding it into two categories: (a) externalized reactions and (b) internalized reactions. The usefulness and the validity of such a categorization then could be tested. Another possibility would be to refer to the evaluation system proposed by Mocellin and Suedfeld (1991) based on two dimensions: pleasantness and arousal. The relevance of these criteria has already been demonstrated.

Another point of view would be to consider that the effects of the third-quarter phenomenon have been overgeneralized. This phenomenon, which is expected to be observed in individual and group adaptation in isolated and confined environments whatever the length of the stay, brings up the question of the definition of the concerned period. According to the results, the phenomenon mentioned above does not really appear just after the middle of the stay at the station but, more precisely, just after the middle of the isolation period at the station. This consideration could be confirmed by a comparative study of the data collected in the French sub-Antarctic bases (Amsterdam Saint-Paul, Crozet, and Kerguelen). Because of the easy and more frequent access to these bases by boat, we cannot consider isolation as having the same consequences in sub-Antarctic stations as the isolation reported by Antarctic winterers. Consequently, isolation is less frequently reported as being difficult with which to cope. In these stations, the absence of a real isolation period (because of the frequency of the boats rotation) may account for the absence of the third-quarter phenomenon.

Finally, the theoretical background and the results we report emphasize the importance of the data collection method when studying the modalities of apparition of the third-quarter phenomenon. Because of the limited number of participants per mission, it is actually difficult to state which method is most reliable to study psychological adaptation with a diachronic approach. Our view, referring to Rivolier (1981), is that self-evaluation questionnaires cannot be considered as a reliable data collection method in isolated and confined environments because of the very strong effect of social desirability. Moreover, this social desirability frequently generates distrust when using peer-ranking questionnaires, even if anonymous.

The winterers were informed that one of the doctor's functions was to assess their adaptation difficulties. Some of them could probably try to hide their weaknesses at the beginning of the stay, but it seems not possible to hide it for an entire year. It also remains important to recall that the doctors' perception of the winter-over may influence the data collection. This perception could lead to an underestimation or an overestimation of the severity of the

reactions, and that is why the telephone calls that regularly took place between the doctor and one of the authors were most of the time very important to control for these biases.

The limited number of participants to Antarctic missions can also explain why few studies allow us to generalize the results to all the missions. However, the impossibility to generalize can also be explained by influence of the group composition. This point of view will be considered in a subsequent research paper.

Before drawing any general conclusions concerning the adaptation to a polar winter-over, subsequent research is required to specify the modalities of adaptation to these conditions. The psychological discomfort and the events that occur during the winter do not affect all members of the group equally (Wood, Lugg, Hysong, & Harm, 1999). Interindividual differences, such as personality and the position of the winterer at the base (researchers or support personnel), are not inconsiderable when understanding the appearance of stress reactions. A previous study revealed differences of adaptation between these different groups of winterers, but also between those who were wintering for the first time and those who had already wintered in Antarctica or at French sub-Antarctic bases (Décamps & Rosnet, 2001). The data that have actually been collected by the bases from the other nations who are members of the Scientific Committee for Antarctic Research (Italy, Argentina, and Australia) will also allow us to draw more informed conclusions concerning cross-cultural differences in participants' reactions toward stress. Furthermore, the diachronic approach of the stress reactions is of great interest for understanding the way in which the winterers adapt to the stressful environmental conditions of polar wintering.

## APPENDIX

### List of the Stress Reactions

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#### Category VI: Thymic Reactions

- Negative or pessimistic feelings
- Sadness, feeling blue
- Boredom
- Brooding about unpleasant things, excessive preoccupation
- Lack of self-confidence or self-esteem
- Muteness
- Lack of motivation to perform usually exciting activities

- Refusal to take any responsibility
- Decision-making difficulties
- Mental and physical slowing down
- Feeling anxious, exaggerated concern
- Feeling guilty
- Subjective tension, mental tension
- Oversensitivity
- Lack of confidence in sexual performance
- Emotional lability
- Hyperactivity
- Excitation
- Unjustified euphoria

#### **Category V2: Social Reactions**

- Withdrawal within oneself
- Strong fear of being misunderstood or underestimated
- Dependency on others, seeking the support of others
- Criticism
- Irritability
- Distrust
- Rigidity
- Strong rivalry with others
- Verbal or physical aggressiveness
- Self-centeredness
- Overdramatization of incidents
- Cause of tension inside the group
- Carelessness about basic social rules

#### **Category V3: Somatic Reactions**

- Insomnia, sleeplessness
- Hypersomnia, sleepiness
- Reversal of sleep-wake cycle
- Decrease in need for sleep
- Nightmares
- Loss of appetite or increase in appetite
- Loss of weight
- Stomach or abdominal pain
- Piles
- Feeling of being suffocated, lump in the throat
- Headaches
- Fatigue
- Sore muscles

- Back pain
- Alcohol abuse
- Drug use

#### Category V4: Occupational Reactions

- Overinvestment in work
  - Ritualistic behavior when undertaking activities
  - Concentration difficulties
  - Inability to complete any task
  - Inability to delegate, to work in a team
  - Overestimation of workload
  - Lack of interest, withdrawal from work
  - High incidence of accidents, nonattendance or incidents at work
  - Underinvolvement and participation in expedition and leisure activities
  - Clear modification in risk-taking behavior
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