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# Transactional Stress: Challenge in a Capsule Environment

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For the past five decades, research into specific features of capsule environments has been of interest to psychologists who study extreme environments. Along with this interest is a corollary theoretical effort to develop a classification system along general dimensions. The main impetus behind this endeavour appears to be a concern regarding the hypothetically harmful impact of the features. This article provides a brief overview of the environmental classification systems of Sells (1973), Harrison and Connors (1984), and Suedfeld (1987), and notes that many aspects of these approaches overlap the revised and more general transactional model of stress proposed by Folkman (2001). The utility of adopting the transactional model of stress as a guide for research into the stresses associated with living in a capsule is then discussed.

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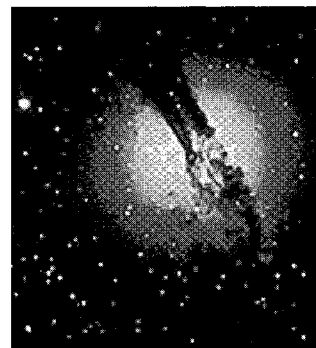
Human beings have long been curious about environments that are considered hostile to human life; places such as the deep sea, the polar regions, and outer space have held our collective interest since their discovery. It may, however, be more than simple curiosity that causes us to explore; one might also reasonably speculate that it is the challenge, the faint possibility within the seeming impossibility, that compels humankind to seek out and "conquer" such places. Such endeavours may be viewed as either noble or foolhardy, but there is no denying that we have a definite fascination with extreme environments. The quote that follows, from a saturation diver aboard one of the SEALAB missions, clearly illustrates the intense interest odd places hold for us.

With those ports open, man, it's great. In fact, I was so interested in those ports I couldn't get to bed ... You'd see a rock fish come up and grab a squid and tussle at this thing, and the squid would grab hold of the glass, and the scorpion fish would try to pull it off, and there'd be a fight right there. Stuff like that just kept you on pins and needles... We would sit and would watch those animals out there by the hour. (Radloff & Helmreich, 1968; p. 112.)

To this date, we have had only one option if we wish to live and work in such environments: build a capsule habitat to provide what Nature does not. However, the unusual characteristics of living inside a capsule, and the extreme, often life-threatening qualities of the external environment, have the potential to adversely affect crew members. Thus, capsules have been traditionally regarded as a source of psychological stress. This article will provide an overview of three taxonomic systems applicable to capsules, and will present an alternative perspective developed in a field of research independent of environmental psychology.

## A Capsule Overview

What is a capsule environment? The list of physical elements that make up capsule environments is extensive, to say the least, and many of these have been investigated for their psychological impact on crew members. Even a cursory glance at the literature reveals a daunting list: unusual atmospheres (Darby & Darby, 1971; Miller & Koblick, 1984; Radloff & Helmreich, 1968); volume, leading to concerns about interpersonal distance, privacy, constricted movement and hypodynamia (Bluth & Helppie, 1986; Christensen & Talbot, 1986; Johnson, 1975; Radloff & Helmreich, 1968); reduced gravity (SIMIS, 1991); and décor (Berry, 1973; Clearwater & Coss, 1991). Other authors and researchers have concentrated on social aspects of confining environments. Here one



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finds an equally lengthy list, including such things as perceived personal control (Ruback, Carr, & Hopper, 1986) and autonomy (Smith & Jones, 1962; Stuster, 1996), role definition (Weybrew & Noddin, 1979), communication (Altman & Haythorn, 1965), and social networks (Johnson, Boster, & Palinkas, 2003). Several authors have attempted to gather this multitude of psychological and physical features into classification systems. Of these, Harrison and Connors (1984), Sells (1973), Suedfeld (1987), and have made noteworthy attempts to catalogue and organise the numerous features of isolated, confining, and physically extreme environments.

Sells (1973) found that most isolated environment researchers commonly identify three dimensions: social isolation, confinement, and sensory restriction. While not questioning the overall validity of these dimensions, Sells did criticize them for being too general to be useful. He suggested that the social system of an isolated group may be divided into seven meaningful categories: 1) objectives and goals; 2) philosophy and value systems; 3) personnel composition; 4) organization (or lack of it); 5) technology; 6) the physical nature of the internal and external environment; 7) and temporal characteristics. An additional category, that of sociocultural factors, was included in a later version of his system.

Sell's (1973) taxonomic system was based on an analysis of the spaceship environment. As such, many of its features can be seen to have direct applicability to the capsule environment. The caveat to be drawn here is that a space *ship* is not a space *station*. Several characteristics of the spaceship may curtail the explicit generalization of Sell's system to larger, less-maneuverable environments: fuel-based payload limitations usually require a small crew and a very constrained cargo and living space; the spaceship is able to direct its location and path of travel; and the spaceship's mission has a geographic beginning and end.

Harrison and Connors (1984) suggested a somewhat less complex classification system. When developing their taxonomic dimensions, they considered a much more extensive set of exotic environments than those simply destined for space. Their analysis resulted in the identification of four key dimensions, or "discontinuities with everyday life" (p. 53) that characterised these environments: the physical climate, both internal and external; the degree and types of dangers; the limits of facilities and supplies; and the extent and nature of social privations.

Unfortunately, these aspects are not orthogonal to one another. Physical climate may pose a danger, limited facilities may necessarily impose social privations, and social privations themselves may lead to dangerous situations if group morale and functioning deteriorate sufficiently.

Thus, the utility of these dimensions as a classification system is somewhat compromised. Despite these overlaps, the dimensions themselves remain as useful descriptive labels for many capsule environment features.

Finally, Suedfeld (1987) has proposed a very concise descriptive model of extraordinary environments. Like Sells (1973), and Harrison and Connors (1984), his classification relies on an assessment of physical features, psychological characteristics of the inhabitants, and the interaction that takes place between these two aspects. However, Suedfeld points out that these broad categories themselves can be rated along the two dimensions of *extremeness* ("the presence of physical characteristics related to danger and discomfort", p.864) and *unusualness* ("the novelty of the environment", p. 864). For example, the highest ranked along the physical dimension would be those environments

in which survival is impossible without advanced technology, which are highly hazardous, and which are inhabited only on experimental or exploratory bases. (p. 864)

This description fits most capsules rather well, although it may be argued that, at least for some longer-term occupants, the degree to which it is unusual is lessening. This has some implications for how psychologists approach extended events such as Antarctic over-wintering and the proposed Mars mission.

### The Transactional Capsule

Thus far, we see that the models concerned with human behaviour in capsule environments are, broadly speaking, dealing with three domains: physical elements, crew characteristics, and the interaction between these two (Suedfeld, 1987). Furthermore, there is a growing belief among theorists that psychological phenomena associated with environments are the result of emergent properties of the person-environment system (Gauvain, Altman, & Fahim, 1983). That is to say, a proper understanding cannot be reached by simply studying the physical and social features separately, or even in interaction. Rather, psychological phenomena are embedded in the highly idiosyncratic, indeed unique, confluence of person(s), place, and time (Altman & Rogoff, 1987; Stokols, 1987; Wapner & Demick, 2002).

This emergent nature has been noted in an area of study related to that of extreme environments: psychological stress. To use Suedfeld's (1987) terminology, living in a capsule is patently an unusual situation for most, if not all, human beings. Despite the familiarity that can develop as a result of extensive training, the capsule is likely to remain a place that is strikingly different from the day-to-day environment in which crew members normally

live. As such, the potential for the capsule to be a source of many types of stressors, from low-level *daily hassles* (Lazarus, 1999; Lazarus & Folkman, 1984) to acute events, is likely to be high. By its very novelty, the capsule is a tin can full of challenges, any of which may be perceived by a crew member as stressful. It should come as no surprise, then, that the progress in psychological theories regarding behaviour in capsule, and similar, environments shows a strong similarity to the changes in theoretical views of human stress.

The evolution of theories regarding psychological stress, independent of environmental psychology, is well covered elsewhere (see, e.g., Cooper, 2001; Lazarus, 1999; Selye, 1993). Succinctly and to a certain extent superficially, one may say that models of stress have followed a similar course to larger trends in psychological theory. Thus, we see initial stress theories that were based in a stimulus-response paradigm that emphasised biological responses (e.g., Selye, 1936). These were followed by person-environment interactive models, which examined the outcomes of interactions between individual cognition and external stimuli. More recently, there has been a move to emphasise context, feedback, and development of stress via iterative processes. With regards to theory and research generation, the most dominant of these latter-day approaches is that of Lazarus and Folkman (1984).

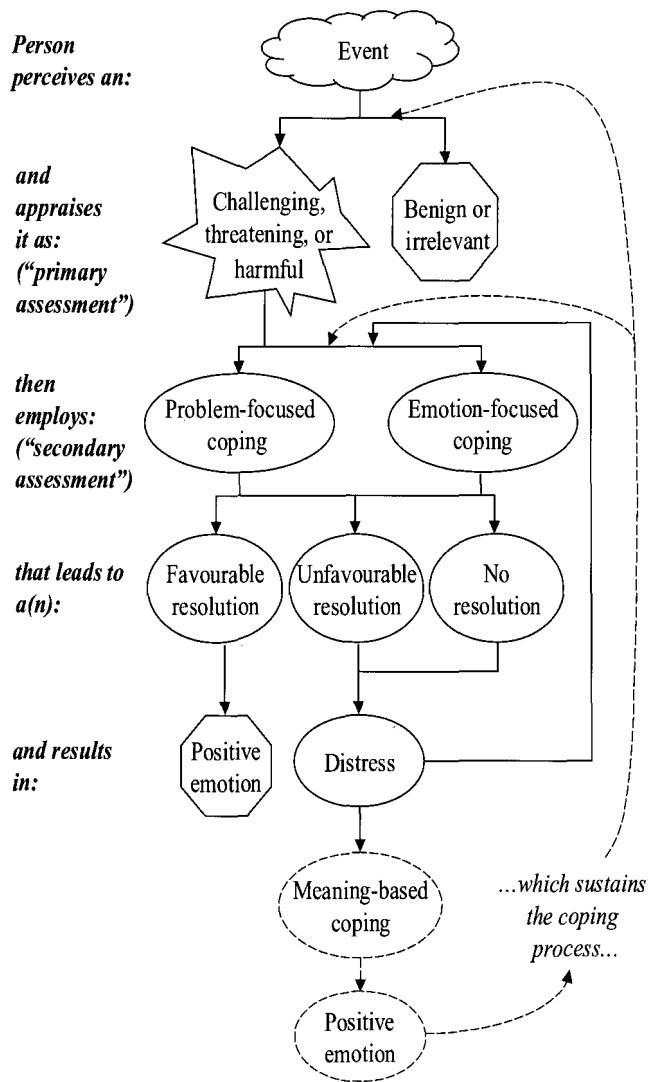
Lazarus and his colleagues (Folkman et al., 1986; Lazarus, 1999; Lazarus & Folkman, 1984) noted that not all people respond to the same noxious event in similar ways. Indeed, human beings can show a rather startling variety of responses to the same stimulus, ranging from despair to exhilaration to boredom. To account for this range, Lazarus and Folkman (1984) proposed their "transactional" model of stress. This model posits that stress arises from the ongoing transactions of the person with their environment. Key aspects of the model include the person's perception and appraisal of potential negative effects (primary appraisal), the person's ability and resources available to meet the demands of the event (secondary appraisal) with problem-focused or emotion-focused coping behaviours, and the emotional response to the outcome of that coping.

The original model has been highly influential in the stress-and-coping literature and, until recently, had not been modified in any significant manner. Folkman (2001), in light of a review of her own and others' empirical results, has suggested that the model now requires extension. It has been noted (Folkman & Tedlie Moskowitz, 2000) that the literature on stress and coping has shown that there are positive outcomes from coping that include "the perception of benefit from the stressful encounter..., the acquisition of new coping skills and

resources..., and spiritual or religious transformation" (p. 648). The major change to the original model is the recognition of the *meaning-based coping* that may ensue in the face of other less-successful coping behaviours, and the positive emotions that may be generated even when things do not turn out as one might wish. Meaning-based coping arises in situations in which a desired outcome may be beyond the control of the person (e.g., internment in a concentration camp, prolonged malnutrition due to drought and poverty, or caring for a terminally ill loved one). It may also appear when a person is confronted with what could be considered an everyday task but which is nonetheless difficult or highly unfamiliar to the person (e.g., paying household accounts after the passing of a life partner) (Folkman, personal communication, May 29, 2003). Such coping takes the form of finding some positive aspect of the situation. Spiritual growth, deepening relationships, and a sense of developing as a human being are examples of trying to find meaning in such situations. The revised model is shown Figure 1, with the modification appearing in dotted lines.

This change to the original model runs parallel with some observations and subsequent theoretical changes in the psychological study of extreme and unusual environments. The shift from the pathogenic focus on research in these environments, represented by the emphasis on "selecting out" candidates not likely to weather the presumed overwhelming mental assault, to a more salutogenic (Antonovsky, 1987) approach, in which it is recognised that individuals are seen as not only resilient but also able to benefit from challenging events in the environment (Oliver, 1991; Palinkas, 1986; Suedfeld & Steel, 2000; Suedfeld, 2001; Suedfeld & Mocellin, 1989), is an outcome of a more general shift in interest to "positive psychology" in the wider discipline (Park, 1998; Park, Cohen, & Murch, 1996; Seligman & Csikszentmihalyi, 2001). Interestingly, the addition of meaning-based coping also brings the transactional model nearly into a conceptual isomorphism with Antonovsky's (1987) "sense of coherence" theory. In his research into the personality traits of survivors of the Holocaust, Antonovsky suggested that three aspects of the person helped them to overcome, and occasionally thrive, in the face of extreme adversity: comprehension of what was taking place, attempts to manage the situation, and the ability to take some meaning, often spiritual, out of what occurred. The connection to primary appraisal, secondary appraisal, and meaning-based coping is obvious.

The conceptual overlap with the three classification models described above is equally clear. The social and physical environmental features described by Harrison and Connors (1984), Sells (1973), Suedfeld (1987), and



**Figure 1.** The transactional model of stress and coping (after Folkman, 2001)

others, can be interpreted as threats or challenges (primary appraisal), and aspects of the person are considered in terms of amelioration of the threat or meeting the challenge (secondary appraisal). Suedfeld's model, in particular, seems very close to the transactional model, with its specification of psychological and physical parameters. However, none of the models appear to give a great deal of consideration to prediction of outcomes, especially what happens when coping strategies are only partially, or not at all, successful. It seems to be assumed that occupants will overcome the difficulties.

The appropriateness of the transactional model's application to capsule environments is clearly enhanced by specification of a variety of outcomes, and the effect

these outcomes have on the stress process. This is particularly so in the case of positive outcomes. The danger, of course, is that the pendulum will swing too far in the "challenge, not threat" direction. Any well-informed researcher in psychology will admit that the field is no more immune to fashionable theory and methods than is any other scientific discipline. Thus, while it is quite necessary to emphasise any potential good that may come out of such experiences, it is equally necessary to remember that such places have the capacity to harm, as well. Thus, it is the revised transactional model's recognition of the distress-eustress continuum that is most relevant for capsule environments.

### The Transactional Model in Application

Much of what is known about capsule psychology has come from research that is, to be blunt, mechanistic and reductionist, the data often stand very much in isolation from one another. It is for this reason, at least in part, that the transactional model has been forwarded as a summary approach. Harrison, Clearwater, and McKay (1991), in advising researchers in our field, have sagely noted that "theories impose order and meaningfulness on observations that might otherwise appear chaotic" (p. 400). While our field has come far from the simple, list-building days of 'stressor' identification, there is still a need for a solid theoretical basis backed by good empirical findings. How, then, might we apply the transactional model to the study of living in capsules?

First, a transactional model implies that compiling a generic list of supposed stressful features may not, in fact, be a very useful pursuit on its own. While it may be possible to identify all potential environmental antecedents, such a list is likely to be very long; we have intimations of this in the empirical work already carried out. Indeed, depending on the detail and level of analysis one wishes to employ, it may be so lengthy as to appear nearly infinite. If what is important is the interpretation of any one or more of these multitude of features, then it would perhaps be wiser to assess the crew members' abilities to cope with stress generally and to attempt to determine which characteristics of a capsule each occupant may find challenging. This procedure resembles the early clinical approach to the psychological selection process. As Santy (1994) has stated, stress tolerance

has always been an essential component of the traditional right stuff. The candidate must be able to endure (not necessarily enjoy) physical and mental discomfort, deprivation, and hardship. A history of character strength in spite of adversity or stressful life situations was thought to be a good indicator of this trait. (p. 103)

It is not surprising that this grimace-and-bear-it characteristic was sought in the early exploration of space and other environments, but capsule living conditions have changed significantly in the ensuing decades (Clearwater & Coss, 1991; Suedfeld & Steel, 2000). This time around, the interviews and assessments may place a greater emphasis on the potential benefits experienced by occupants, and on developing and strengthening techniques for overcoming perceived stressors (Suedfeld, 2001).

Second, Figure 1 suggests that when coping does not result in a favourable resolution for the person, attention and effort may be re-directed back into appraisal and coping. The recursive aspect of the stress process has been noted before (see, e.g., Lazarus & Folkman, 1987), but the components recently added by Folkman (2001) create new implications for capsule occupants and ground crew responsible for psychological assessment. For example, the manifestation of positive emotion after a period of distress may not be a particularly good indicator of the end of the stress process. It may simply signal employment of meaning-based coping. Such coping is very useful inasmuch as it allows the distressed person to continue functioning, but it may lead external observers to assume that "all procedures are nominal".

Finally, stress is a process, and outcome variables often become the input variables for the actions and emotions that follow. Therefore, on-going monitoring of the crew member during the mission by a person or people knowledgeable about him or her is highly desirable. As Dawes (1994) has argued, a person in such a role need not have an advanced degree in psychology or psychiatry to be effective as long as he or she has training in the basic principles of psychology. Similar monitoring and follow-up during what is probably the least considered of all mission stages, re-entry into the member's usual environment, is equally important (Suedfeld & Steel, 2000).

All of these stages are, of course, part of any good psychological program associated with capsule missions these days. Thus, the forwarding of the transactional model of stress to describe capsule environments is more in the way of an offering of an explanatory tool than an admonitory message. It may also serve to guide research in that it provides a succinct and common way of describing an area of concern for psychologists more generally interested in extreme and unusual environments. As occupancy of capsule environments increases in duration, as well as the number and variety of people, it begins to move toward the slightly less novel and more mundane. It is perhaps appropriate that psychologists involved in research involving capsule inhabitants look towards more mainstream models, such as the transactional theory of stress, to guide their thinking.

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