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Anxiety and the Regulation of Complex Problem-Situations:

Playing it Safe?

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Summary

According to Schönpflug, an ecologically valid model of behavioral regulation should contain antecedent, focal, and consequential problem variables while allowing for a classification of primary versus auxiliary actions. To study individual differences in dynamic problem solving, the task simulation RISK is introduced. Within this task, highly anxious subjects were expected to demonstrate a greater safety expertise because of a hypothesized tendency to focus on risks and modify them. The results, however, indicated a preference for a more narrow focus: Highly anxious subjects directed their regulatory efforts primarily to focal and consequential problem variables. Yet, in RISK, this was a safe and also successful strategy.

Anxiety and the Regulation of Complex Problem-Situations:
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Anxiety and Behavior: Problem-Solving Strategies

Anxiety is a well-known everyday experience. At a quick glance, it may appear to the layperson as a simple, quasi holistic phenomenon. Taking a close look, however, one soon realizes that there are at least three systems involved when experiencing anxiety: the verbal, the physiological, and the behavioral system (cf. Lang, 1985). In situations that arouse the feeling of anxiety, all three systems usually will react. Furthermore, since the influential work of Charles Spielberger (1966, 1972), researchers discriminate between anxiety as a transitory emotional state and anxiety as a stable personality trait. With regard to these two dimensions, the present chapter focuses on individuals with high trait-anxiety and their behavioral strategies in dealing with complex problem situations.

Anxiety is a popular research field. Looking only into PsycLIT's CD-ROM abstracts and only into the years from 1977 to 1995, one can easily retrieve over 7,000 journal articles that have the very word "anxiety" in their title, not to mention the several times more frequent publications that deal with anxiety despite a different main focus. Still, only a small percentage of this research is about anxiety and overt behavior, and this percentage gets even smaller when it comes to molar instead of molecular processes. Consider for example test-anxiety research. While there are many studies investigating performance deficits in high test-anxious individuals (cf. the meta-analyses of Hembree, 1988, and Seipp, 1991), the number of studies dealing with regulatory strategies of how to compensate for these deficits is much smaller. For high-anxious individuals, heightened effort expenditure may be a means to compensate (see, e.g., Schönpflug, 1992), but as this is a rather simple, molecular strategy, it might have only limited generalizability to molar environmental variables (Baum, 1989).

Therefore, one should also look at molar strategies, e.g., differences in problem-solving behavior itself. Most of the studies that are looking at problem-solving strategies, however, depend on self-report measures. In all probability, these studies are biased not just because of common method variance but also because of the high-anxious persons' negative look on both their personality and their abilities. When asking individuals about successful problem-solving strategies, it hence cannot surprise that most studies consistently show negative correlations between reported anxiety and reported behavior (e.g., Herrmann, Liepmann, & Otto, 1987; Stäudel, 1988).

Consequently, studies on behavioral regulation should not rely on self-reports only, especially when it comes to the assessment of problem-solving strategies. Besides, since the advent of microcomputers, psychology has received another powerful method apart from observation in the field, namely computer-simulations of ecological problem tasks.

Simulating Ecological Problem-Situations

The Lohhausen Simulations and Their Problems

In 1983, a book was published which had a considerable impact on the German psychology of problem solving. "Lohhausen. Problem solving in uncertain and complex problems" (Dörner, Kreuzig, Reither, & Stäudel, 1983), so the title of this book, introduced to psychology a new method for studying problem solving, namely the study of how individuals were regulating complex computer-simulated scenarios. Lohhausen itself is the simulation of a small town of 3,400 citizens. Like an ordinary town of this size, Lohhausen has a small factory, a bank, restaurants, shops, a school, and, of course, a town hall with a mayor. In the Lohhausen studies, the participants had to take the role of the mayor of the town -- a mayor vested with omnipotent powers -- and then to regulate the Lohhausen system for a simulated time span of 10 years.

Compared with classical, well-specified problems such as the Tower of Hanoi (cf. Hyes & Simon, 1977) or Luchins' water jug problems (cf. Atwood & Polson, 1976), the individuals who are solving a complex problem-simulation must satisfy quite different requirements (Funke, 1992, p. 25): "(1) they must deal with the complexity of the situation and with the connectivity of the variables involved; (2) they must deal with the intransparency or opaqueness of the situation since typically not all information that is needed is available; (3) they must deal with dynamic developments of variables which change their states autonomously and make it necessary to anticipate trends" -- everything just like in the "real world".

Partly due to this high ecological face-validity, the study of complex problem solving became very popular in the German-speaking countries. Numerous new scenarios were constructed, the most popular being "Moro" with the problem-solver acting as a Peace Corps worker in a third-world country (e.g., Strohschneider, 1986), "Tailorshop" with the problem-solver acting as the manager of a small shirt-factory (e.g., Süß, Kersting, & Oberauer, 1991), and "Fire" with the problem-solver acting as the head of a complex fire-fighting operation within a simulated forest region (e.g., Schoppek, 1991).

However, the fast-growing field of complex problem solving soon started to encounter problems of its own (cf. Funke, 1992). First, while questioning the validity of traditional intelligence tests, the dependent measures of the complex problem-solving tasks themselves often were of doubtful reliability and validity. Second, results from one study could not easily be generalized to other scenarios. Finally and most important, the study of complex problem-solving often lacked a theoretical background which could integrate all the singular findings about different people regulating different scenarios in different ways. What, for example, does it <u>mean</u> when in the Moro simulation one person concentrates on fighting the tsetse fly while another person focuses on building water-wells? Beyond the description of good versus poor strategies, there was and still is a need for a general, psychological frame of reference both for the variables of problem situations and for the actions of problem solvers.

Dynamic Problem Situations: A Psychological Frame of Reference

Following the guidelines of the research program outlined by Schönpflug (1979a), our research group developed a frame of reference for the study of general and individual strategies in the regulation of simulated ecological problem-settings. Based on a set of propositions about how to portray the environment within psychological theories (Schönpflug, 1979b), Schönpflug developed a taxonomy for both variables in problem situations and actions in problem solving. This taxonomy therewith was used in the theory-based construction of eco-psychological problem-scenarios that also would allow for testing predictions about behavioral strategies of high-anxious subjects.

With regard to variables, a problem situation can be modeled as a problem network that consists of three classes of variables. Considering their successive structure, these variables can be conceived of as focal problems, antecedents, and consequences (Schönpflug, 1984, p. 698). The variables of central interest are the focal problems; their state is crucial to the system. Therefore, they constitute the genuine problem variables (P). While these problem variables are influenced by antecedents or risks (R), they themselves again influence consequential variables or consequences (C). Both problems and consequences are variables of high affective valence, whereas the risks are not. Risks by themselves constitute no problem to be coped with; their potential lies only in the fact of directly aggravating focal problems and thereby indirectly aggravating negative consequences (Schönpflug, 1987, August). Figure 1 shows Schönpflug's basic model for one focal problem.

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With regard to actions, Schönpflug takes up a conceptualization of the Polish psychologist Tomaszewski (1978). According to his theory, the spectrum of regulatory operations can be divided into primary and secondary actions. Primary actions are productive, directly goal-oriented operations whereas secondary actions are merely supportive to the primary actions. Secondary actions once more can be divided into auxiliary actions and preventive actions, e.g., detecting risks in order to safeguard primary actions (see Mündelein & Schönpflug, 1983, p. 74).

In addition to these variables and actions, an eco-psychological problem-scenario should provide an option to disengage from regulatory operations. In this respect, Schönpflug distinguishes between disengagement as giving up and disengagement as an instrumental act. "In social systems, disengagement may be a strategy to engage other people's help for one's own problems, thus transferring the task to somebody else" (Schönpflug, 1985, p. 186). In dynamic problem-scenarios, there may as well be times when the problem solver can transfer the task to "somebody" else, namely to the simulated environment. When everything is going well by itself, one should deliberately disengage. Otherwise, regulation might lead to self-generated problems and cause new sources of stress (Schönpflug, 1985). Consider, as an example, watering your flowers too much or too often; instead of flourishing, they probably will become ill and eventually die.

To summarize, an ecologically valid model of complex problem-situations should contain antecedent, focal, and consequential problem variables and provide options to engage in primary and secondary actions as well as to disengage from regulatory behavior. These then were the directives when programming the RISK simulations.

<u>The RISK Simulations</u>

In the RISK simulations (Schönpflug, 1986), there are three classes of variables: risks (R), focal problem variables (P), and consequences (C). While all risk variables influence all problem variables and all problem variables again influence all consequence variables, only problems and consequences are of high affective valence according to Schönpflug's frame of reference. Within the RISK simulations, this is achieved by instruction: the subjects are told that they may manipulate the variables of all three domains. At the end of a simulation, however, only the states of problem and consequence variables will count. Consequently, problem and consequence variables will be referred to as "the goal variables" (cf. Figure 2).

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In line with other studies on dynamic systems, RISK is intransparent: first, the subject does not know the exact nature of the interconnectivity; second, the states of all variables are not automatically provided to him/her. Basically, the problem solver has three options in dealing with the uncertainty and complexity of this RISKy situation. On each step, he/she has to decide whether (a) to check the current state of a variable (orientation) or (b) to modify a variable (modification) or -- since the simulation is dynamic -- (c) simply wait for one step (disengagement). Modifying variables without prior orientation, however, can be detrimental to the situation: if variables already are in a good state, a modification will do worse instead of better! And when antecedent variables deteriorate, this has a negative influence on all successive variables.

When antecedent variables are in a good state, however, this has a positive influence on all successive variables. By this construction, RISK allows for choosing an individual strategy on a continuum whose extreme points are the following two opposite strategies:

regulating the risks and thereby indirectly controlling the goal variables versus neglecting the risks and directly regulating the goal variables (cf. Figure 2).

Apart from permitting individual goal-oriented strategies, Schönpflug's RISK simulation has the further advantage of being open to different problem presentations. Since Schönpflug's model is a general frame of reference for complex problems, various situations can be modeled within the RISK shell. Up to date, there exist three versions: (1) a simulation of different settings in the work of tank-lorry drivers (Müller, 1991; Müller, Schönpflug, & Stöber, 1990), (2) an abstract, semantic-free version (Stöber, 1990), and (3) the original health version (Schönpflug, 1986; Stöber, 1990; see Figure 2). As the main focus of this chapter is on anxiety, methods and results from the study of Stöber (1990) will be used to demonstrate this line of research.

Anxiety and the Regulation of Complex Problem-Situations

Anxiety, Risk, and Safety

Returning to the study of anxiety, what predictions can be derived for interindividual differences in dealing with the variables and the action options within the RISK simulations? In his 1989 article on anxiety, prospective orientation, and prevention, Schönpflug reflects on a possible safety expertise in individuals with high levels of anxious worry. According to Schönpflug, orientation and prevention are intimately related to worries. "Whereas orientation leads to the construction and verification of worries, . . . preventive acts are designed and executed in order to modify the course of threatening events" (Schönpflug, 1989, p. 248). Consequently, high-anxious individuals should operate like "safety experts" who attentively scan the environment for potential risks and, if they detect any, try to modify them. Evidence in support of this idea can be found, e.g., in the studies by Butler and Mathews (1987) about high-anxious subjects having a heightened risk-perception or in the research by Beck (cf. Beck, Brown, Steer, Eidelson, & Riskind,

1987) about anxiety being characterized by the theme of danger. Within the RISK simulations, one therefore would expect that high-anxious individuals show more secondary actions, that is generally more active orientation and specifically more risk regulation.

However, there are certain reservations concerning these hypotheses. Already Schönpflug (1989, p. 256) points out that "as a strong emotional state, anxiety seems not to be favorable for sophisticated cognitive elaborations and detailed preparation and prevention." Due to limited processing capacity (cf. Eysenck, 1979), one would expect of the high-anxious subjects a fairly poor problem-solving performance (see the meta-analyses cited
above). Yet, as previously mentioned, studies regarding actual behavior of high-anxious individuals are sparse, particularly studies regarding molar behavioral variables. Therefore, it still is an open question whether or not previous findings generalize to strategic preferences of high-anxious individuals when dealing with a rather complex task. But before looking closer at interindividual differences in simulated situations, one should take a close look at the situations first.

Tailoring RISK for the Study of Anxiety

Some psychological situations are "powerful to the degree that they lead everyone to construe the particular events the same way [and] induce uniform expectancies regarding the most appropriate response pattern" (Mischel, 1977, p. 347). In order for individual differences to make a difference, however, the situation must be sufficiently "weak". If the problem-task should be sensitive to individual strategies, it must provide enough degrees of freedom on the path to a solution.

To guarantee that a high problem-solving score can be attained with different strategies, it was necessary to test the RISK simulation before the main study. This was done by simulating different simple strategies that systematically varied the percentage of modifications directed at the risk variables. Stepwise, the parameters of the RISK program were adjusted until a solution was found that resulted in approximately equal problem-solving scores along the continuum between regulating only the risk variables and regulating only the goal variables (cf. above). Accordingly, the final version of RISK does not impose a certain strategy onto the individual and thus obstruct the relevation of personal preferences: a person with a preference for focusing on risks and a person with a preference for focusing on problems and consequences, they both can obtain the same problem-solving score as the following results will show.

Anxiety and RISK: Playing it Safe

A total of sixty subjects completed the trait scale of the State-Trait Anxiety Inventory (German version by Laux, Glanzmann, Schaffner, & Spielberger, 1981). Afterwards they had to play the RISK simulation with the objective to regulate the simulated problem-situation for 100 cycles. On each cycle, the subject had to decide whether to look up the state of a variable (orientation), to modify the variable (modification), or to sit out for one cycle (disengagement). Subjects were told, that after 100 cycles the game would be over and a problem-solving score was computed by looking at the state of the goal variables (viz., problem and consequence variables) while the state of the risk variables would be of no relevance. The better states they would achieve for the goal variables the better their problem solution would be. To improve the reliability of the dependent measures, each subject had to solve the RISK simulation four times so that the scores could be aggregated.

First of all, the results show no difference with regard to secondary actions: high-anxious subjects do not engage more in active orientation. However, a significant difference between high- and low-anxious subjects was found for the three classes of problem variables (see Figure 3). While there is no difference in regulating the risks (R), high-anxious subjects concentrate their effort on the goal variables. Summing across actions (orientations plus modifications) and variables (problems plus consequences, i.e., P + C), there is a highly significant effect for trait-anxiety. When regulating the RISK environment, high-anxious individuals more closely stick to the central variables with both orienting and modifying actions. Instead of regulating the goal variables by controlling the risks, they rather monitor the central variables and modify them when their states change unfavorably.

Yet, is this a successful strategy? In the context of the given task, it is. With the anchors being 0% when all goal variables are in the worst possible state and 100% when they all are in the best possible state, high- and low-anxious subjects arrive at the same problem-solving score (63.2% versus 60.0%, $p = .60$, two-tailed). Because RISK was designed to allow for different strategies, ignoring the risks is not too risky so that high-anxious subjects regulate the problem-situation with the same effectiveness as low-anxious subjects.

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But what about effort? While arriving at the same problem-solving score, high-anxious subjects choose the option "disengagement" significantly less often than low-anxious subjects (see Figure 3). Consequently, an efficiency score was calculated by dividing the standardized problem-solving score by the standardized frequency of all regulatory actions. Thus, while being as effective as low-anxious subjects, high-anxious subjects turn out to be slightly less efficient (with $p < .06$, one-tailed, this difference is marginally significant).

Conclusions

At the first look, the results of this study corroborate theories and results that stress the dysfunctional aspects of anxiety. Being as effective, but expending more effort, high-anxious subjects are less efficient, a result well in accordance with Eysenck's processing efficiency theory (cf. his chapter in this book). Besides, the results of this study also can be interpreted within the frame of attentional phenomena associated with anxiety where "high trait anxiety has been found to be associated with a reduction [italics added] in the breadth of attention in conditions permitting focused attention" (Eysenck, 1992, p. 76) as it is the case in the RISK simulations.

From another point of view, however, the results can be seen quite differently. First, in this self-paced task, high-anxious individuals do not invest more time in regulating the RISK simulation -- a finding that would not speak for a lesser efficiency. On the contrary, one could even argue for a greater efficiency of the highly anxious because they cut down the problem tree and concentrate on the main variables. Furthermore, choosing the strategy to rather ignore the risks could be interpreted as problem-solving restructuration by elimination of implicit constraints (Richard, Poitrenaud, & Tijus, 1993). Regulating predominantly problems and consequences, the highly anxious limit their task space for both active orientations and modifications. Instead of caring for distal risks, they set a proximal subgoal, which is a means for boosting one's perceived self-efficacy (Stock & Cervone, 1990). Solving a more simplified model of a complex model, that is solving RISK with lesser risk regulations, might be a "weak method" (cf. Polson & Jeffries, 1985). In the RISK simulation, this is a valid and -- with regard to the goal variables -- safe strategy.

Nevertheless, disregarding potent risks hardly is a safety strategy. Although the high-anxious individuals know about the risks, they do not use a preventive strategy. Instead, they engage in regulatory behavior that could be described with the ugly German word

"Symptombehandlung", meaning that someone is treating only the symptoms but not the causes -- a rather narrow focus on ecological problem networks.

Therefore, the search for problem situations where anxious strategies are expert strategies is still on. But, no matter whether you look for safety expertise (Schönpflug, 1989) or catastrophes (Hardy & Parfitt, 1991), anxiety research as well as the study of complex problem-solving sure can benefit from a macro-level perspective like Schönpflug's, that is a perspective on both situational variables and individual actions within a general, eco-psychological model of regulation and disregulation.

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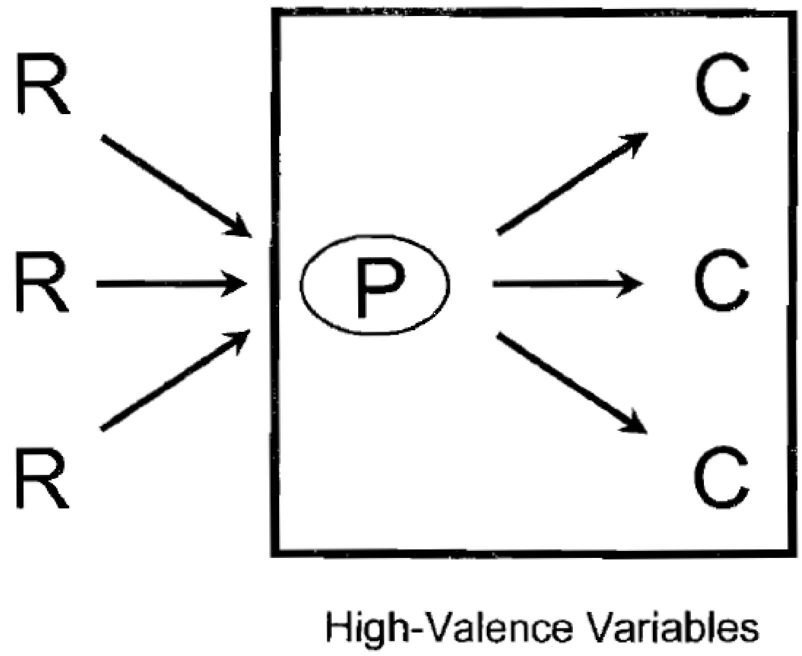

Figure 1. Schönpflug's model of problem variables.

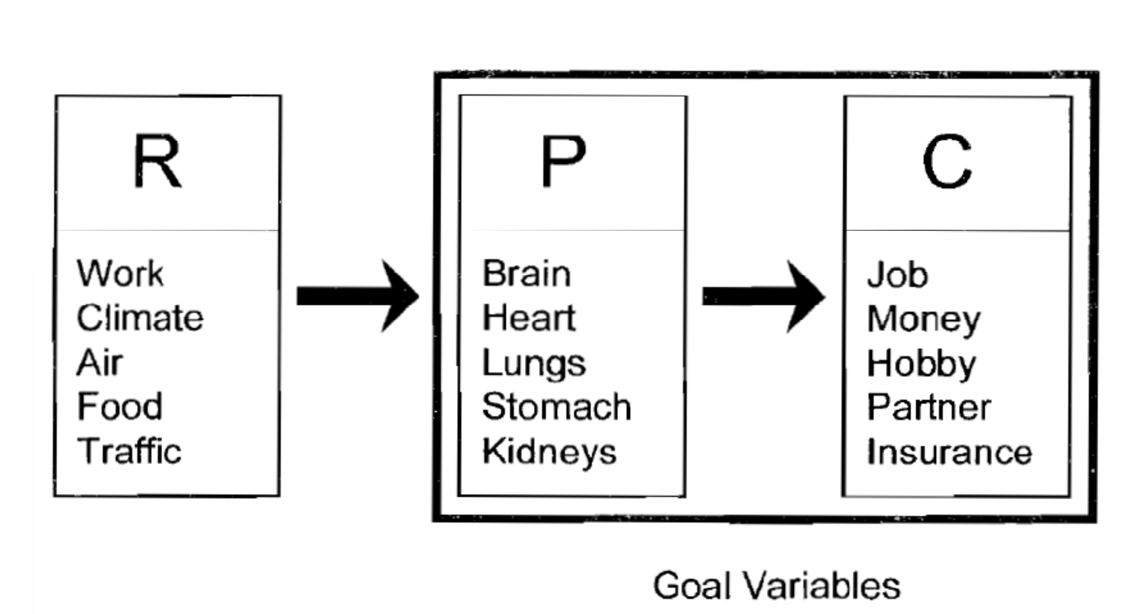

Figure 2. The health version of Schönpflug's RISK simulation.

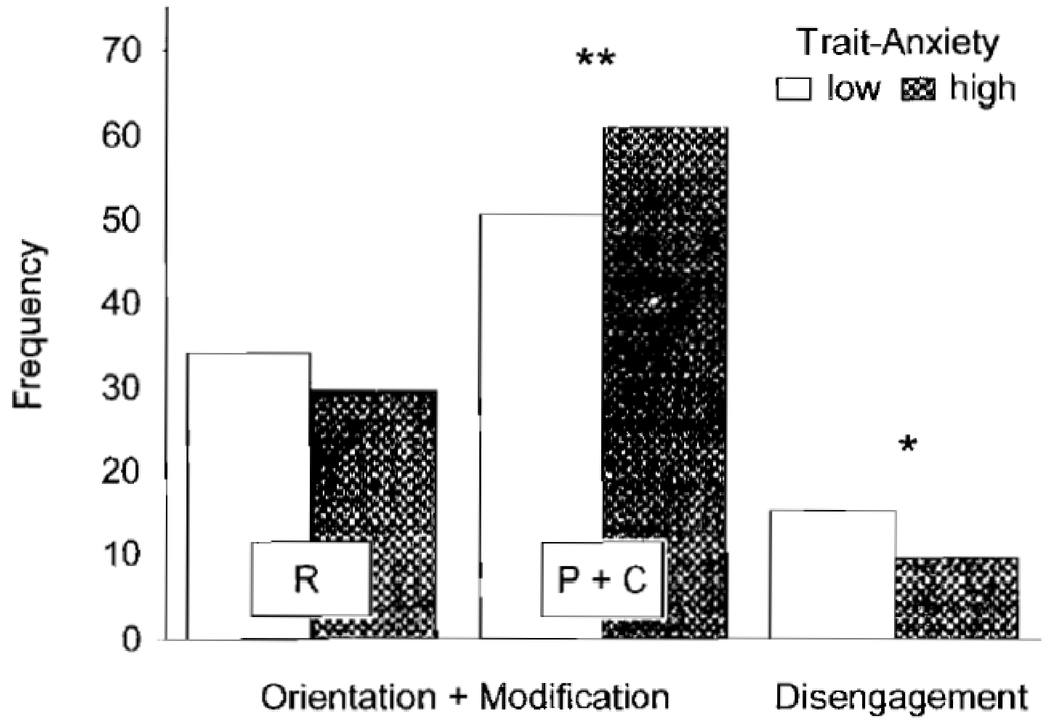

Figure 3. Trait-anxiety and the frequency of regulatory actions in the RISK simulation.

N = 60. * $p < .05$, ** $p < .01$, one-tailed.