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Self-Appraised Problem-Solving Skills and the Prediction of Secondary Complications Among Persons with Spinal Cord Injuries

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Secondary complications following spinal cord injury (SCI) include decubitus ulcers and recurrent urinary tract infections. These conditions can significantly impair quality of life and prove life-threatening; it is also believed that these conditions are mediated by behavioral pathways. According to the social problem-solving model, persons who report effective problem-solving skills should be capable of adhering to long-term therapeutic regimens of self-care necessary to prevent these complications. We tested this assumption in the present study. Discriminant function analyses revealed self-appraised skills in approaching and defining problems contributed to the prediction of secondary complications among 53 persons with SCI. Results are discussed in light of the social problem-solving model, and the utility of problem-solving interventions in rehabilitation is explored.

KEY WORDS: spinal cord injury; self-appraisal; problem-solving; treatment compliance.

INTRODUCTION

Although the mortality rates and quality of life for persons with spinal cord injuries (SCI) have steadily improved with medical advancements over the years, these individuals often incur debilitating secondary complications that impair physical and psychosocial functioning. These complications can

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include decubitus ulcers and recurrent urinary tract infections (UTIs). Decubiti evolve from the restriction of blood flow and supply to certain regions of the skin, depleting oxygen and gradually eroding skin tissue. The ulcerated tissue can vary in severity, and treatment typically ranges from reduced pressure and restricted activity to the affected area in less severe cases to surgical skin-flap repair and prolonged bed rest in severe cases. The etiology of urinary tract infections is less clear (cf. Stover, Lloyd, Waites, & Jackson, 1989), but it is probable that infections result from the presence of bacterium in the urinary tract, occasionally accompanied by fever and chills. Initially, UTIs were associated with a greater incidence of renal failure among persons with SCI. Improvements in bladder management, detection, and intervention have lessened the life-threatening nature of infection, but recent research indicates that bacterium can develop resistance to traditional treatments of antibiotics (Waites, Canupp, & DeVivo, 1993b).

Behavioral adherence to therapeutic regimens is believed to be instrumental in preventing the incidence of decubiti, and to a lesser extent, urinary tract infections. For example, it is recommended that persons with SCI routinely engage in pressure reliefs (approximately every 30 min) to restore blood flow to constricted areas and conduct daily skin inspections over the body to detect any possible breakdown. Individuals are also encouraged to consume adequate amounts of water and observe a healthy, balanced diet to ensure proper nutrients for skin maintenance. Bladder management entails the routine care and maintenance of apparatus for emptying the bladder at predictable intervals, often with the use of intermittent catheterizations (ICPs) or with the use of an external condom catheter. Failure to change and clean the apparatus routinely can increase the likelihood of bacterium in the urinary tract. Similarly, inappropriate ICP technique can damage the urethra and increase the likelihood of infection. Finally, heavy consumption of fluids and failure to observe schedules for voiding can distend the bladder, fostering a more accommodating environment for bacterial infections (Waites, Canupp, & DeVivo, 1993a).

We need to distinguish characteristics of those at risk for developing secondary complications and those who seem less likely to incur these problems. Coping with a chronic physical condition like SCI necessitates daily, ongoing self-care, exemplified by conscious, instrumental efforts to comply with therapeutic regimens. Unfortunately, nonadherence is most likely to occur when compliance involves complex self-care regimens on a daily, long-term basis, with little or no observed relation to eventual outcomes (Turk & Meichenbaum, 1989). Nevertheless, many psychological characteristics—particularly those of a cognitive nature—are often predictive of

recovery among persons with chronic medical conditions, and instrumental, problem-focused strategies are best suited for coping with chronic and ongoing health conditions (Auerbach, 1989). Psychological variables are more predictive of mortality rates among persons with SCI than demographic and medical status variables (Krause & Crewe, 1987). Effective interpersonal problem-solving skills have been associated with greater therapeutic compliance among persons coping with chronic illness (Fehrenbach & Peterson, 1989). It is theoretically plausible that persons with more effective problem-solving skills would be likely to recognize and implement adaptive strategies to adhere to self-care regimens and prevent the occurrence of secondary complications after the onset of physical disability.

Theoretical formulations of social problem solving describe two broad components: problem orientation and problem-solving skills. The problem orientation component entails the attitudes and thinking styles necessary (a) to ward off negative emotions (e.g., depression, anxiety, anger) that can hamper problem solving, (b) to elevate positive affect and perceived efficacy that can facilitate effective problem solving, (c) to inhibit impulsive, random, and unplanned attempts at problem solving, and (d) to motivate a person toward problem solving (D'Zurilla & Nezu, 1990; D'Zurilla & Sheedy, 1991; Nezu & D'Zurilla, 1989). This component, then, serves primarily as the motivational set in the model. The problem-solving skills component—consonant with the original D'Zurilla and Goldfried (1971) model—is comprised of the specific, goal-directed cognitive-behavioral strategies of defining a problem, generating alternatives, choosing a solution, and implementing and monitoring the progress of the selected strategy.

Contemporary study has usually relied on the Problem-Solving Inventory (PSI; Heppner, 1988) as the preferred measure of problem-solving abilities. The PSI contains three empirically derived factors that assess different aspects of the problem solving delineated in the original D'Zurilla model. The Personal Control (PC) factor assesses perceived abilities in regulating emotional and behavioral reactions in problem-solving situations (e.g., "I make snap judgments and regret them later," "Sometimes I get so charged up emotionally that I am unable to consider many ways of dealing with my problems"). The Problem Solving Confidence (PSC) factor measures the degree of confidence in one's ability to handle problems (e.g., "I have the ability to solve most problems even though initially no solution is immediately apparent," "I trust my ability to solve new and difficult problems"). These factors approximate the problem orientation component of the social problem-solving model: They assess motivational aspects of problem solving and perceived abilities in regulating cognitive, behavioral, and

emotional reactions that can hinder or promote problem solving (Elliott, Herrick, MacNair, & Harkins, 1994; Nezu & Perri, 1989).

The final factor—Approach-Avoidance (AA)—measures the recognition and use of specific cognitive-behavioral skills as described in the problem-solving skills component (e.g., "After I have solved a problem, I do not analyze what went right or what went wrong," "I have a systematic method for comparing alternatives and making decisions"). Thus, the problem orientation component (as measured by the PC and PSC factors) should be predictive of self-reported attitudes and affect, and the problem-solving skills component—as measured by the AA factor—should be predictive of instrumental tasks and subsequent outcomes. As such, the latter component should be predictive of the occurrence of problems with a clear behavioral pathway, assuming that a person with effective problem-solving skills would be more inclined to recognize and exercise adaptive behaviors.

Recent studies using the PSI in the realm of behavioral health have supported the theoretical properties of these two components. A negative problem orientation has been associated with the increased use of emotion-focused coping strategies (MacNair & Elliott, 1992) and menstrual-related pain complaints of undergraduate women (Elliott, 1992) and with increased health complaints under routine and stressful conditions among undergraduates (Elliott & Marmarosh, 1994). A negative problem orientation among persons with SCI is predictive of greater depression and psychosocial impairment secondary to the disability (Elliott, Godshall, Herrick, Witty, & Spruell, 1991). Other research has found a positive orientation to be associated with greater positive mood and less negative mood under general and stressful conditions (Elliott, Sherwin, Harkins, & Marmarosh, 1995) and with less hopelessness, depression, and pain-related suffering among persons with chronic low back pain (Witty & Bernard, 1994). The influence of a positive problem orientation on ongoing positive and negative affects has been linked with lower levels of peripartum and postpartum depression (Elliott, Shewchuk, Richeson, Pickelman, & Weaver-Franklin, 1994). In contrast, effective problem-solving skills have been associated with the use of problem-focused coping techniques (MacNair & Elliott, 1992) and rational decision-making strategies (Chartrand, Rose, Elliott, Marmarosh, & Caldwell, 1993; Phillips, Pazienza, & Ferrin, 1984) among undergraduates, and with greater intentions to behave assertively among persons with SCI (Elliott *et al.*, 1991).

Unfortunately, this research has relied almost exclusively on self-report criterion measures. Tests of the presumed relation of the problem-solving skills component with objective, behavioral-based outcomes are especially needed to advance our understanding of the

problem-solving model. Empirical support for the model could have considerable implications for problem-solving interventions in the rehabilitation setting. We addressed this issue in the present study. Persons who have severe physical disabilities and who report a greater recognition and use of specific problem-solving skills would theoretically be more inclined to attend to self-care issues, assume a greater responsibility for their health, and adhere to recommended self-care regimens prescribed by the rehabilitation team. Therefore, we predicted that effective problem-solving skills would be significantly associated with the documented occurrence of decubiti and urinary tract infections among persons with SCI. No relation was expected between the problem orientation variables (PSC, PC) and secondary complications.

METHOD

Participants

Participants were 53 persons with SCI who were receiving services from a Veterans Administration Medical Center (Richmond, VA). The sample was almost exclusively male (one female). Thirty-eight patients were Caucasian, 14 were African American, and 1 was Hispanic American. Thirty-six participants had injuries resulting in paraplegia and 17 in tetraplegia. The sample averaged 136.79 (SD = 148.71; range, 1 to 490) months since the onset of injury at the time of the initial interview. Participants averaged 44.68 (SD = 14.05; range, 20 to 66) years of age and 12.61 (SD = 2.69) years of formal education. Twenty-one persons had incomplete lesions of the spinal cord; 32 persons had complete lesions.

Patients were approached by a member of the research team and informed that the study examined the relationship between interpersonal behavior and adjustment to SCI. Informed consent was obtained from interested participants. The predictor and criterion measures were administered in a random order. Trained interviewers verbally administered the measures to patients, since many patients with high-level injuries required assistance. Interviewers also noted the reason for hospitalization for each patient. Following a year after the initial interview with the patients, medical records were reviewed for the occurrence of UTIs and pressure sores during the follow-up year. Of the original number of participants from the VAMC (N = 74; Elliott, Herrick, & Witty, 1992), medical records were available for 53 persons 1 year after the interview. Data from these records were used in later analyses.

In the initial interview, 20 persons in the final sample of 53 reported treatment for skin-related problems. Five persons reported treatment for bladder problems, five were receiving routine "check up" evaluations, eight gave miscellaneous reasons for treatment (e.g., chronic pain, ulcers, etc.), and three reported cognitive dysfunctions (e.g., memory problem, stroke). Three patients gave no reason for medical treatment and three others reported more than one reason for hospital services. Twelve patients had been injured less than 1 year, 6 had been injured from 1 to 3 years, and 35 had been injured for over 3 years.

Predictor Variables

The Problem Solving Inventory—Form A (PSI; Heppner, 1988) was used to measure self-appraised problem-solving ability. The PSI contains 32 items, which are rated on a 6-point Likert scale (1 = strongly agree to 6 = strongly disagree). The PSI contains three factors described earlier: Problem Solving Confidence, Approach Avoidance, and Personal Control (Heppner, 1988). A total score is derived by summing the factor scores. Reliability estimates reveal that these constructs are internally consistent (α coefficients from .72 to .90) and stable over a 2-week period [test–retest correlations from .83 to .89; (Heppner, 1988)]. Validity estimates indicate that the PSI total score and subscales are significantly related in predicted directions with a variety of self-report and observational measures (Heppner, 1988). Higher scores indicate negative perceptions of one's problem-solving ability.

Demographic Information. Time since the onset of injury, patient level of injury, and degree of cord lesion were deemed clinically important as predictor variables. Past research has found contradictory relations between each of these variables and the incidence of secondary complications among persons with SCI (e.g., Anderson & Andberg, 1979; Fuhrer, Garber, Rintala, Clearman, & Hart, 1993; Rodriguez & Garber, 1994). Time since injury was calculated in months. The date of injury was either elicited from the patient or taken from the patient's file. We included a log transformation of the time variable in our analyses. Patient age was solicited in the initial interview. Persons with paraplegia were coded as 1 and persons with tetraplegia were coded as 2. Finally, the completeness of the spinal cord lesion was recorded as this variable can substantially affect physical function and mobility (coded as 1 = incomplete, 2 = complete).

Criterion Variables

Occurrence of Urinary Tract Infections (UTIs) and Decubitus Ulcers. Two raters perused medical files after 1 year following the initial interview. Raters reviewed discharge reports by attending physicians summarizing the progression of patient treatment for each hospitalization. These reports made clear reference to the incidence of a decubitus ulcer or urinary tract infection. Individuals who did not have a decubitus ulcer were coded as a 1; individuals with at least one decubitus were coded as a 2. Similarly, the documented diagnosis of a UTI was coded as 2, and the absence of such was coded as 1. Interrater agreement was calculated using Cohen's κ as an indicator of the proportion of agreement between raters after chance agreement was removed from consideration. This coefficient was calculated for both of the criterion grouping variables. The results revealed acceptable interrater agreements for the occurrence of decubitus ulcers (Cohen's κ = 1.0) and for UTIs (Cohen's κ = .92). Two discrepancies were found on coding of UTIs that could not be resolved by a third coder due to the language on the discharge report. These discrepancies were coded as an absence of UTIs in all further analyses.

Statistical Analysis

A discriminate functional analysis is a preferred procedure for determining which variables differentiate between groups of individuals, or in which the researcher wishes to predict group membership on the basis of a discriminant function. As a priori relations between patient characteristics and secondary complications could not be anticipated, we employed a stepwise procedure in our analyses. This procedure uses the predictor variables in the most effective manner for predicting group membership on the criterion variable. A stepwise procedure enters and removes variables one at a time, selecting them on the basis of whether that variable minimizes the sum of unexplained variation between groups. This procedure enters first the variables that account for the most variance in the prediction of group membership. In addition, this procedure creates the most predictive discriminant function from the remaining variables. The stepwise order in which the variables are entered suggests the relative importance of each variable toward the prediction of group membership.

We conducted two discriminant analyses to predict membership in two groups: nonoccurrence of decubitus ulcers and occurrence of decubiti. We then computed a second discriminant function analysis, using the same predictor variables to determine membership in two categories of urinary

problems: nonoccurrence of UTIs and occurrence of UTIs. The analysis and subsequent computations were conducted according to directions provided by Tabachnick and Fidell (1989).

RESULTS

Means and standard deviations for the social support scales, the PSI factor scores and demographic variables for each equation are presented in Table I. Table II displays correlations between the demographic and the problem-solving variables.

Table I. Means and Standard Deviations for Demographic and Problem-Solving Variables Use in Discriminant Analyses

	Mean	SD
Lesion	1.60	.49
Level of injury	1.32	.47
Time since injury	3.98	1.73
Problem-solving variables		
Approach-Avoidance	34.47	8.65
Personal Control	14.02	6.03
Problem Solving Confidence	21.17	6.93

Note. Lesion coded as 1 = incomplete, 2 = complete. Level of injury coded as 1 = paraplegia, 2 = tetraplegia. Time since injury is a log transformation of the number of months since injury onset. Lower scores on all self-appraised problem-solving variables denote greater effectiveness.

Table II. Correlation Matrix of Variables Used in Discriminant Analyses

	TSIL	PSC	AA	PC	Lesion
Level	.00	−.13	.04	.01	−.02
Lesion	−.08	.22	−.06	−.02	—
PC	−.02	.42**	.30*	—	
AA	−.11	.50**	—		
PSC	.07	—			

Note. Level, level of injury (paraplegia = 1, tetraplegia = 2); TSIL, time since injury in months (log transformation); PSC, Problem Solving Confidence; PC, Personal Control; AA, Approach-Avoidance; Lesion, type of SCI lesion (1 = incomplete 2 = complete). $N = 53$.

*$p < .05$.

**$p < .01$.

In the prediction of decubiti diagnosis, time since injury was selected at the first step as a significant predictor (see Table III). A more recent onset of injury was associated with greater likelihood of developing decubiti. At the second step, tetraplegia was associated with a greater likelihood of decubiti diagnosis. At the third and final step of the equation, the Approach-Avoidance factor significantly augmented the prediction of decubiti diagnosis. Ineffective AA scores were significantly associated with the occurrence of decubitus ulcers, as expected. The final equation accounted for 21% of the variance in predicted group membership. As displayed in Table IV, 84.91% of the cases were correctly identified, including 94.6% of the cases with actual documented occurrence of a decubitus.

Table III. Results of Stepwise Discriminant Function Analysis to Predict Classification for Decubitus Ulcers

Predictor variable	Standardized discriminant function coefficient	Wilk's λ	Equivalent F^a
Time since injury	-.61	.910	5.02* (1,51)
Level of injury	.51	.850	4.53* (2,50)
Approach-Avoidance	.56	.791	4.31** (3,49)
Canonical *R*	.46		
Eigenvalue	.26		

[a]Degree of freedom for each *F* test in parentheses.
*$p < .05$.
**$p < .01$.

Table IV. Results for the Prediction of Membership in Decubitus Ulcers Categories

		Predicted group membership	
Actual group	No. of cases	No ulcer	Ulcer
No ulcer	16	10 (62.5%)	6 (37.5%)
Ulcer	37	2 (5.4%)	35 (94.6%)

"Grouped" cases correctly classified: 84.91%

The next equation—to predict documented occurrence of a urinary tract infection—selected Personal Control at the first of the equation (see Table V). This variable approached significance ($p = .063$), and the direction of the coefficient suggested self-appraised skills in regulating emotional and behavioral reactions when problem solving was associated with a UTI diagnosis. At the second step, Approach-Avoidance was selected as a significant predictor. Consistent with theoretical reasoning, effective AA scores were again characteristic of those who had no documented occurrence of a secondary complication. An extended length of time since injury onset was significantly associated with a diagnosed UTI at the third step of the equation. Finally, type of lesion was added at the fourth step. Incomplete lesions were significantly associated with documented occurrence of a UTI in this sample. The final equation accounted for 24% of variance in the criterion variable, and this model correctly classified 77.36% of the cases (see Table VI). As with the previous analysis, the equation was particularly useful in the prediction of persons with documented occurrence of UTIs (87.50%).

DISCUSSION

Reasoning from the social problem-solving model, we expected that effective skills in generating, evaluating, implementing, and monitoring so-

Table V. Results of Stepwise Discriminant Function Analysis to Predict Classification of Urinary Tract Infections

Predictor variable	Standardized discriminant function coefficient	Wilk's λ	Equivalent F^a
Predictor Control	−.47	.934	3.62 (1,51)
Approach-Avoidance	.41	.34	4.96* (2,50)
Time since injury	.34	.790	4.42** (3,49)
Lesion	−.35	.760	7.80** (4,48)
Canonical R	.49		
Eigenvalue	.32		

[a]Degrees of freedom for each F test in parentheses.
*$p < .05$.
**$p < .01$.

Table VI. Results for the Prediction of Urinary Tract Infection Categories

		Predicted group membership	
Actual group	No. of cases	No UTI	UTI
No UTI	29	20 (69.0%)	9 (31%)
UTI	24	3 (12.5%)	21 (87.5%)

"Grouped" cases correctly classified: 77.36%

lutions to everyday problems would be predictive of behaviorally mediated health complications. Persons with SCI who do not have effective problem-solving skills should incur more secondary complications that often result from nonadherence to therapeutic regimens; persons with effective skills would be more likely to recognize the importance and utility of recommended self-care strategies and would be more likely to integrate these recommendations into routine health behaviors, thereby preventing the development of potentially life-threatening and costly complications. Our results supported this logic: Effective problem-solving skills—as assessed by the Approach-Avoidance factor on the PSI—significantly characterized those patients who had no documented evidence of decubitus ulcers or urinary tract infections 1 year after initial interview once other characteristics were taken into account.

Our findings converge with and extend prior research. Effective AA scores have been associated with greater use of rational decision making strategies (Chartrand *et al.*, 1993), greater willingness to be assertive (Elliott *et al.*, 1991), and increased use of problem-focused coping strategies (MacNair & Elliott, 1992). This constellation of behaviors characterizes a proactive style that may be crucial in optimal adjustment in the face of chronic and long-term health conditions. A person with SCI who recognizes and endorses the use of specific problem-solving skills would thus be more likely to attend to behavioral self-care regimens that encompass routine pressure reliefs, good nutritional habits, daily skin inspections, and hygienic bladder management techniques at regular intervals. The present study is the first to associate the problem-solving skills component with health outcomes believed to be mediated in part by behavioral mechanisms.

Some caution is warranted in interpreting our results, as we did not directly assess self-care behaviors among our participants. Nevertheless, our findings are supportive of recent attempts to integrate descriptive PSI re-

search with current notions of social problem solving (e.g., Elliott *et al.*, 1995). As expected from this integrative model, elements of the problem orientation component were unrelated to the occurrence of secondary complications. While this component serves as the motivational set for problem solving, it should be correlated primarily with adaptive attitudes of the self and the environment and with self-report variables with an affective dimension (Elliott *et al.*, 1995). The development of a secondary complication after SCI, however, was believed to be an indicator of poor cognitive-behavioral strategies subsumed by the problem-solving skills component.

One finding was somewhat inconsistent with certain tenets of the social problem-solving model. Specifically, an element of a positive problem orientation was associated with a greater likelihood of urinary tract infections among patients. Although this relation failed to meet conventional levels of statistical significance ($p = .063$), this trend suggests that perceived abilities in regulating emotional and behavioral reactions when problem solving might be related to a greater risk for developing a UTI or, alternatively, this variable statistically suppressed the relation of the AA factor to the criterion variable. Any interpretation of this observed association is post hoc and tenuous; future research is ultimately required to consider and replicate this finding in an a priori manner.

In contrast to our consistent findings regarding AA scores, we observed no clear pattern in the relation of demographic variables to the incidence of secondary complications in this sample. A recent SCI was associated with decubiti diagnosis; SCI of greater duration was associated with a UTI. Tetraplegia was associated with documented occurrence of decubiti, although early research indicated that persons with paraplegia might be more at risk for skin ulcers (Anderson & Andberg, 1979). The lack of consistency in these findings and the subsequent lack of convergence with the extant rehabilitation medicine literature probably reflect the inherent flaws in building atheoretical explanatory models from demographic variables. Demographic characteristics are ultimately dependent upon the vagaries of each clinic. Patient characteristics vary across treatment sites and catchment areas and across samples volunteering for participation. Therefore, theoretically derived models that explicate behavioral mechanisms in the development of secondary complications will likely evidence greater convergence in the literature.

More importantly, theoretical models that include behavioral explanations ideally provide meaningful directions for clinical interventions. Our findings support the integration of problem solving interventions into SCI rehabilitation programs. In our programmatic research, self-appraised problem-solving abilities have been linked in theoretically consistent directions with markers of optimal psychosocial and medical adjustment among per-

sons with SCI. A positive problem orientation has been associated with less depression and psychosocial impairment regardless of time since the onset of injury (Elliott *et al.*, 1991), and effective problem-solving skills have been associated with a greater likelihood to behave assertively (Elliott *et al.*, 1991). An overall effective problem solving set might interact with certain types of social support to expedite psychosocial adjustment (Elliott *et al.*, 1992).

Intervention research has documented that problem-solving training is effective in alleviating depression among community-residing adults (Nezu & Perri, 1989) and elderly individuals (Arean *et al.*, 1993), reducing hopelessness and despair among suicidal adolescents (Lerner & Clum, 1990), and promoting the acquisition and utility of specific self-management skills among undergraduates (Richards & Perri, 1978). In SCI rehabilitation, training in the problem orientation component can help patients learn skills in identifying emotions that cue the existence of a problem and learn how to regulate and monitor emotional and behavioral reactions to problems. Patients can be taught to engage and value more thoughtful, planful, and goal-oriented efforts at solving problems imposed by acquired disability. Self-regulatory skills, in particular, can enhance favorable opinions about the self and stave off prolonged experiences of negative emotions that can impair problem-solving efforts (Nezu & D'Zurilla, 1989).

Training in the problem-solving skills component can help patients identify problem encountered in attending to self-care regimens for diet, physical activity, monitoring of health and symptoms, prescription compliance, and recommended techniques for conducting pressure reliefs, skin checks, catheterizations, and inspection and care of assistive equipment. These elements require individuals thoughtfully to participate in their health care. Patients can learn how to generate and evaluate possible solutions, select and implement the best available options, and monitor subsequent progress. Combined training in a positive problem orientation and in problem-solving techniques that integrates actual problems encountered in SCI rehabilitation and community adjustment may prove most beneficial. Current research indicates that patient knowledge of self-care skills is insufficient to prevent the occurrence of secondary complications; psychosocial interventions that assist patients in learning and applying this information need to be developed and evaluated in SCI rehabilitation (Rodriguez & Garber, 1994). Interventions embedded in a problem-solving framework may be pivotal in helping patients learn and employ self-care skills in an adaptive manner. Future research should examine the efficacy of problem-solving interventions in rehabilitation programs.

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