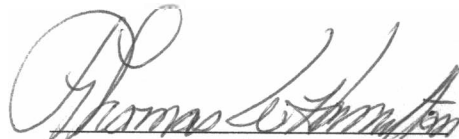


**Short-term Recovery from Total Knee Replacement as a Function of Locus of  
Control**

Submitted in partial fulfillment of the requirements for graduation with honors to  
the Department of Psychology at Carroll College, Helena, MT

Rachel A. Ferraro  
April 7, 2003

This thesis for honors recognition has been approved for the Department of  
Psychology by:



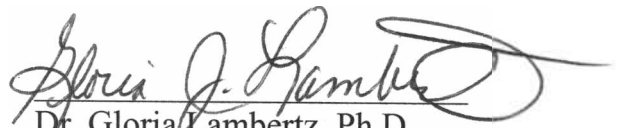
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## Abstract

This study explored the psychological factor of locus of control and how it may relate to short-term recovery from total knee replacement. A group of ten patients (aged 49-74 years) undergoing total knee replacement received a pre-operative psychological assessment. Each patient, prior to surgery, completed the Rotter's locus of control inventory. External vs. internal locus of control was identified from each completed inventory. The post-operative outcome was assessed in terms of the number of days it took to attain key physical therapy milestones such as unassisted straight leg raise repetitions, 90-degree leg bend, and number of hours spent completing continuous passive motion prior to hospital discharge. These dependent variables were evaluated using physical therapist-evaluated progress, a continuous passive motion (CPM) machine, and a goniometer to measure joint angles and patients' range of motion. A positive increase in internal locus of control was associated with a shorter recovery time to achieve a straight leg raise, higher degrees of 90-degree leg bend improvement, and more hours on the CPM machine. It is concluded that locus of control appears to be useful in the rehabilitation process and this psychological variable could be gainfully integrated into a pre-operative assessment for total knee replacement.

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## Introduction

The widespread practice and remarkable success of prosthetic joint implant surgery has significantly enhanced the quality of life for many individuals afflicted with degenerative, arthritic, or injured joints (Mariani & Tuan, 1998). Total knee replacement (TKR) is the second most common type of joint replacement surgery after hip replacement (Kendell, Saxby, Farrow, & Naisby, 2001). Total knee replacements are routinely performed in order to alleviate severe knee discomfort, disability, rheumatoid arthritis, osteoarthritis, and also to promote and restore functional mobility in many suffering individuals. Prosthetic joint replacement is an invasive surgery, and subsequent physical therapy sessions are necessary and important in the post-operative phase of rehabilitation. Total knee replacement recovery is associated with some of the most painful post-operative rehabilitation, as it requires an aggressive approach of physical therapy in order to restore joint mobility. The good news is that the aggressive physical therapy regimen is often successful in diminishing pain and increasing functional mobility and range of motion in patients who undergo this procedure. For total knee replacement patients to achieve a sufficient range of motion and ample joint mobility before they are able to be discharged from the hospital, there are some key physical therapy milestones that are fundamental to enable these patients to return to their daily living with minimal assistance (Robins, Kerina, & Coultts, 1993).

The effects of the psychological variable of locus of control are manifest through many empirical research studies. This psychological construct stems from Julian Rotter's (1954) social learning theory and refers to the extent in which an individual perceives reinforcements as being contingent on his or her own behavior. The attitudes that prevail and the reinforcement expectancies are labeled as "internal" or "external" locus of control (Carlisle-Frank, P., 1991). This construct is frequently assessed by means of the Rotter's Locus of Control Scale (Rotter, 1966), which identifies locus of control as either internal or external. This measuring device has been widely used to assess perceived locus of control in many areas of research, including health-related research.

This particular study aimed to appraise whether or not there is a functional relationship between short-term recovery from total knee replacement surgery and the psychological factor of locus of control. Locus of control may be a mediating psychological factor that affects the recovery progression. The general hypothesis is that there is a significant difference in improvement in short-term recovery from total knee replacement as a function of locus of control.

## Literature Review

Existing health-related research exploring the recovery of patients from total knee replacement is limited regarding short-term recovery. Research investigating mediating psychological factors in the recovery process is also limited when it comes to short-term rehabilitation. However, there is research linking recovery from surgery and psychological factors (Mathews & Ridgeway, 1981). Scheier and Carver report that individuals with a high internal locus of control not only perceive more personal control, they also cope better with stressful events and enjoy better health. Additional research has illustrated that internals also respond to stressful events with smaller increases in blood pressure and they recover more quickly from surgery (Everson, Goldberg, Kaplan, Cohen, Pukkala, Tuomilehto, & Salonen, 1996). Further studies have demonstrated that when humans feel unable to control their environment, stress hormone levels rise and immune responses, involved in the healing process drop (Rodin, 1986). However, much research remains to be done in the area linking psychological factors, such as locus of control to the short-term recovery process in prosthetic joint surgeries.

Significant differences in physical therapy milestones are evident in the success rate among patients with TKR undergoing a physical therapy regime (Kendell *et al.*, 2001). For this reason, gaining knowledge about factors that mediate success in attaining post-operative physical therapy milestones may be useful. Both gaining a greater understanding of how these psychological factors

may impose an influence in the rehabilitation process and identifying these factors in individual patients before surgery could be valuable. By identifying mediating factors pre-operative, a therapy intervention could be manipulated to best suit the patient's needs (Kendell *et al.*, 2001). Enhancing the effectiveness of total knee replacement therapy is particularly important in respect to the research finding that "the range of motion of the knee joint achieved by discharge predicts the range of motion at one year, after which time, there is unlikely to be any further improvement" (Maloney, Schurman, Hangen, Goodman, Edworthy, & Block, 1990). Therefore, it is of clear importance that the immediacy of effective post-operative therapy be implemented during early recovery.

## **Materials & Methods**

### Participants

A group of eleven male patients scheduled to receive TKR at Fort Harrison Veterans Hospital in Helena, MT were chosen to be a part of this study in the spring of 2003. Data was collected during the months of January and February, as there were an adequate number of patients scheduled to undergo total knee replacement surgery. The sample size of  $N=10$  is due to the limited number of patients receiving total knee replacements at this Veterans Hospital. However, a sample size of  $N=10$  is still sufficient to perform statistical analysis on the data. Permission was granted to obtain physical therapy rehabilitation measurements and psychological variable evaluations. Each patient's identity remains anonymous, as only numerical data was utilized for this study. One patient's data was excluded from this study due to post-surgery complications, as his knee became infected upon early discharge. This complication of infection inhibited the typical post-operative therapy protocol. Of the ten remaining patients, all were Montana residents, prior veterans, Caucasian-American, and married. Age ranged from 49-74 years, with a mean age of 61 years.

### Independent Measures Protocol

The psychological variable of locus of control, or internal-external attitudes, is a psychological measure of a person's belief regarding the causal relationship between his or her own behavior and outcomes. This construct was chosen to be the independent measure that was evaluated by an abridged version

of the Rotter's locus of control scale (Nowicki & Duke, 1974). Individuals are determined to have a locus of control that is either internally or externally founded. Those individuals who are evaluated by Rotter's scale to have an internal locus of control view themselves as the chief determinants of their situation. They believe both positive and negative events are a consequence of their own actions and thereby under personal control. In contrast, those evaluated by Rotter's scale to have an external locus of control view external factors as the primary determinants of their situation. They believe both positive and negative events are not linked to their own behavior and thereby beyond personal control. An internally founded vs. an externally founded locus of control was assessed in all eleven patients prior to surgery. The Rotter's locus of control inventory was utilized in order to obtain a numerical measure denoting either an internal vs. an external locus of control in each individual. Scores ranging from 16-40 indicate an internal locus of control, thus a sense of personal responsibility for health status. Scores below 0-15 indicate an external locus of control, thus a sense of external factors as responsible for personal health status.

#### Physical Therapy Dependent Measures Protocol

The scope of this paper will emphasize three of the chief physical therapy milestones that are achieved after the completion of a total knee replacement surgery. There are additional exercises that are utilized during the rehabilitation process, but this paper will investigate straight leg raise, progression toward the 90-degree leg bend, and continuous passive range of motion as they may relate to

the psychological factor, locus of control. Each patient was evaluated for eight consecutive days following the completion of their operation, with rehabilitation tactics employed the day after the total knee replacement. The average hospital stay of a total knee patient is eight-ten days at this Veterans hospital, therefore, eight days of measurements were recorded on each of the patients utilized in the study to facilitate consistency in the analyzing process. Recovery following total knee replacement surgery was assessed by recording the progress and time for each patient to achieve the mentioned key milestones. The outcome measures chosen were: number of days to achieve ten repetitions of straight leg raise; number of degrees attained toward the progression of a 90-degree bend of the knee; and the number of hours invested into the continuous passive motion (CPM) machine. Therefore, the three dependent variables were quantified by numerical measures of days, degrees, and hours.

The first dependent variable of straight leg raise is achieved by elevating the affected leg 6-8 inches without bending the knee, utilizing minimal to no therapist assistance. This variable was quantified by the number of days individual patients took to achieve 10 straight leg raise repetitions (Figure 1). This exercise promotes strengthening of the quadriceps muscles, primarily the rectus femoris. It is imperative that this muscle maintains or even gains strength, as it is one of the chief muscles in attaining knee joint movement (Kendell *et al.*, 2001). It is essential to implement quadriceps-strengthening exercises so as to prevent these muscles from atrophying due to inactivity.

The second dependent variable of progressing toward or attaining 90-degree leg bend in the affected knee is achieved by bending the affected leg with physical therapist assistance. The progressing measurements of leg bend can be measured with a physical therapy tool called a goniometer. The goniometer should be aligned on one end with the greater trochanter of the hip and the lateral epicondyle of the femur, and the other end should be aligned with the lateral malleolus of the ankle (Figure 2). The resulting angle is the leg bend measurement. The 90-degree leg bend can also be measured by the continuous passive motion (CPM) machine. This apparatus is useful in progressing toward and attaining a 90-degree leg bend. The CPM is used because as a surgery incision heals, scar tissue forms. The scar tissue is less elastic than normal tissue and lack of movement may create adhesions, or improperly healed tissues. A CPM machine is permissive of motion and prevents problems with adhesion-breakage that results in severe pain and swelling. The CPM protocol requires resting the affected leg in a padded frame. The machine gently moves the joint to a specified degree of flexion (Figure 3). The therapist and the patient decide on this degree. The speed of the CPM machine is adjusted to an individual comfort level. (Smith & Nephew, 2001).

The third dependent variable evaluated in this study was the total hours spent on the CPM machine during the eight-day duration of hospital therapy. The CPM has many advantages. The machine administers controlled, passive motion, which increases blood flow to the joint. The increased blood brings nutrition to

the joint to alleviate swelling and promote mobility in the healing joint (Smith & Nephew, 2001). This variable of hours on the CPM was quantified for each patient by summing hourly totals over the eight-day period. This particular variable was chosen to be included in the study because there are great differences in the duration that individual patients are able to withstand the continuous passive motion machine.

#### Procedure for Administering the Scale

Prior to surgery, each patient was given the 34 question abridged version of the Rotter's locus of control scale (Nowicki & Duke, 1974). Each scale, upon completion, was then scored to determine whether the patient exhibited an internal or an external locus of control. The locus of control spread of the ten patients was as follows: six were assessed to exhibit an internal locus of control and four were assessed to exhibit an external locus of control. Following surgery, each patient was evaluated on the three dependent measures, as described by the preceding protocol. All measurements were recorded for the eight days following TKR surgery. After all data had been collected and quantified on the six internals and the four externals, statistical analysis was performed to determine whether or not a functional relationship existed.

### Data Quantification and Statistical Analysis

Three response variables were analyzed separately. These were:

- Number of days to achieve straight leg raise
- The total leg bend (flexion) degrees gained during the hospital stay
- The total number of hours spent on the CPM machine

To quantify the effect of locus of control on each of the three dependent variables, three t-tests were performed to establish whether or not there was a significant difference between internal vs. external dependent measures. T-test one investigated whether there was a significant difference between internal and external number of days to achieve a straight leg raise. T-test two examined whether there was a significant difference between internal and external number of degrees attained (gain scores) in leg bend. T-test three explored whether there was a significant difference between internal and external number of hours spent on the CPM machine. A t-test was utilized because it assesses whether the means of two groups are statistically different from one another. Statistics were carried out using Microsoft Excel Data Analysis software package.

## Results

### T-test one

Table 1 depicts that individuals with an internal locus of control demonstrated significantly faster achievement of straight leg raise having a mean of 2 days during the eight-day test periods compared with subjects with an external locus of control who had a mean of 3.5 days,  $T(8)=2.48$   $p<.05$ .

### T-test two

Table 2 depicts that individuals with an internal locus of control demonstrated significantly higher degrees of leg bend improvement with a mean of 40.67 degrees during the eight-day test periods compared with subjects with an external locus of control who had a mean of 30.5 degrees,  $T(8)=3.28$   $p<.01$

### T-test three

Table 3 depicts that individuals with an internal locus of control demonstrated significantly more hours on the CPM machine with a mean of 29.99 hours during the eight-day test periods compared with subjects with an external locus of control who had a mean of 16.75 hours,  $T(8)=3.82$   $p<.01$ .

**Table 1.** Comparisons between the means of internal and external locus of control straight leg raise measures.

Patient	Internals (days)	Externals (days)
1	1	2
2	2	5
3	2	3
4	3	4
5	2	
6	2	

Internals= those evaluated to have an internal locus of control  
 Externals= those evaluated to have an external locus of control

t-Test: Two-Sample Assuming Equal Variances  
 $\alpha=0.05$

	Internals	Externals
Mean	2	3.5
Observations	6	4
Df	8	
t Stat	-2.48424	
t Critical one-tail	1.859548	

This t-test shows that internals achieve a straight leg raise significantly faster than do externals at the 0.05 level of significance.

**Table 2.** Comparisons between the means of internal and external locus of control degree attainment (gain scores) of leg bend.

Patient	Internals (degrees)	Externals (degrees)
1	45	32
2	42	35
3	43	27
4	42	28
5	30	
6	42	

Internals= those evaluated to have an internal locus of control  
 Externals= those evaluated to have an external locus of control

t-Test: Two-Sample Assuming Equal Variances  
 $\alpha=0.01$

	Internals	Externals
Mean	40.66667	30.5
Observations	6	4
Df	8	
t Stat	3.281159	
t Critical one-tail	2.896468	

This t-test shows that internals attain significantly higher degrees of leg bend improvement than do externals at the 0.01 level of significance.

**Table 3.** Comparisons between the means of internal and external locus of control CPM hours.

Patient	Internals (hours)	Externals (hours)
1	28	20
2	36	15
3	31	11
4	25	21
5	22	
6	34	

Internals= those evaluated to have an internal locus of control

Externals= those evaluated to have an external locus of control

t-Test: Two-Sample Assuming Equal Variances

$\alpha=0.01$

	Internals	Externals
Mean	29.33333	16.75
Observations	6	4
Df	8	
t Stat	3.822325	
t Critical one-tail	2.896468	

This t-test shows that internals invest significantly more hours than do externals at the 0.01 level of significance.

## Discussion

There were significant differences found in this study, however, there are limitations to applying and interpreting this data. A limitation to this particular study is that a small sample size, *N*, was utilized. Limitations and drawbacks to empirical research in this area is that existing post-operative recovery data is mainly derived from patients in long-term rather than short-term recovery. It is evident from the literature that understanding more about short-term recovery is pertinent because in the case of total knee patients, immediate rehabilitation gains are predictive of long-term functional mobility (Kendell *et al.*, 2001).

In study after study, “internals” act more independently, feel less depressed, and enjoy better health than do “externals” (Lachman & Weaver, 1998; Presson & Benassi, 1996). Further support for superior health and recovery in “internals” is in the literature regarding investigations on the link between locus of control and health-facilitating behavior. This research denotes that internal locus of control seems to be a mediating factor of measures taken to recover from and avert health problems (Carlisle-Frank, 1991). One of these health-facilitating behaviors is physical activity, whose relationship to locus of control has been studied. Sonstroem and Walker (1973) studied locus of control and attitudes toward physical fitness and found that individuals with an internal locus of control favored physical activity to a greater extent, attained notably higher fitness scores, and exercised more frequently and longer in duration on a voluntary basis than did

individuals with an external locus of control (Carlisle-Frank, 1991). In relation to this research, this finding may suggest that internals may be more prone to favor therapy exercise as well as perform these physically grueling therapy regimes longer, more often, and more willingly. Parallel to health-facilitating behavior research, studies on individuals attempting to overcome health-damaging circumstances, such as surgery, have also revealed that individuals with an internal locus of control are frequently more successful than individuals with an external locus of control (Carlisle-Frank, 1991). Internal locus of control has been noted to have beneficial effects on physical well-being, perhaps by encouraging either effective coping or feelings of competence (Daniels & Guppy, 1997).

In conclusion, findings in this particular study suggest that an earlier achievement of straight leg raise, higher degrees of 90-degree leg bend improvement, and more hours spent on the continuous passive motion machine are associated with an internally founded locus of control. This finding seems to be supported by numerous claims that internals are more accountable and proactive in their life circumstances, thus they achieve significantly more progress and faster TKR rehabilitation than those with an external locus of control. It is concluded that locus of control appears to be useful in the rehabilitation process and this psychological variable could be gainfully integrated into a pre-operative assessment for total knee replacement. Externals may need a longer length of therapy duration as well as more motivation on the part of the therapist.

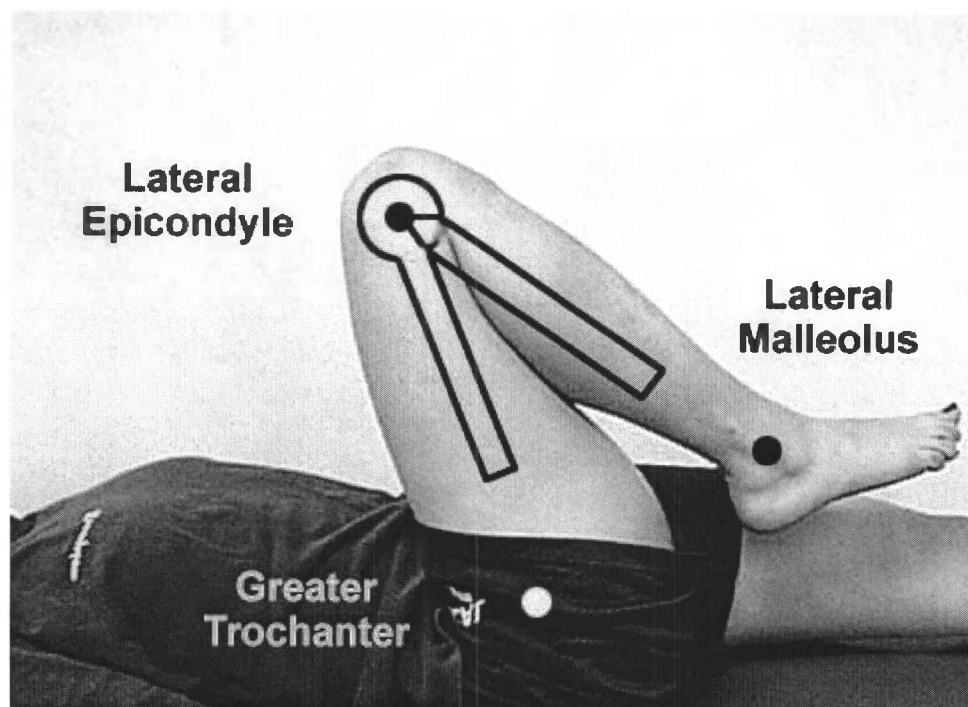
**Figure 1.** Depiction of the dynamics of straight leg raise in TKR patients



Bend non-surgical leg. Raise involved leg 6-8 inches with knee  
Straight. Hold for 3 seconds. Repeat 10 times. Do 3 sessions per day.

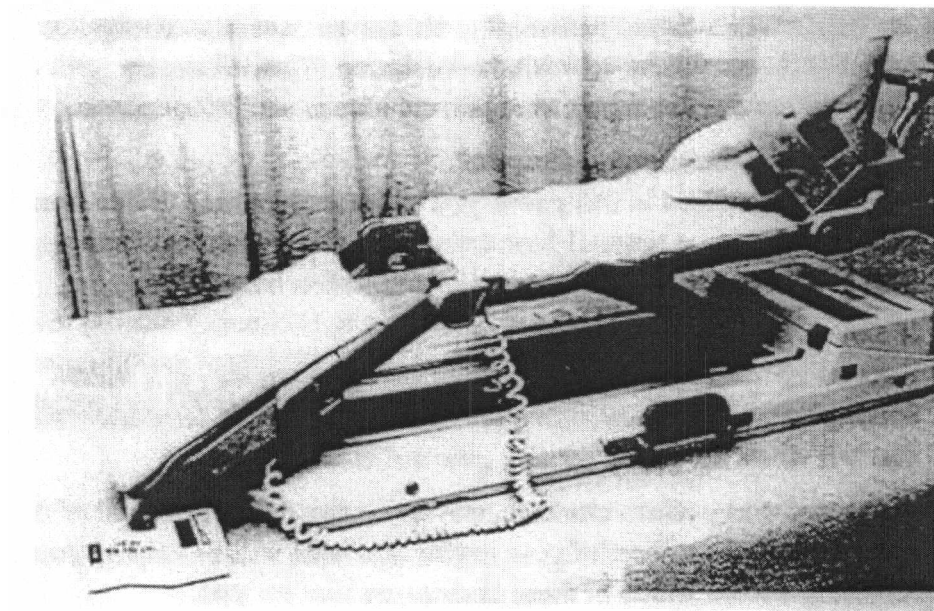
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**Figure 2.** Portrayal of a 90-degree leg bend measuring tool; a goniometer



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**Figure 3.** Depiction of a CPM machine used to attain joint mobility



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## Appendix A

### Locus of Control Scale

#### Instructions:

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Answer the following questions the way you feel. There are no right or wrong answers. Don't take too much time answering any one question, but do try to answer them all. One of your concerns during the test may be, "What should I do if I can answer both yes and no to a question?" If it does, think about whether your answer is just a little more one way than the other. Try to pick one or the other for all questions and not leave any blank. Mark your response to the question in the space provided on the left.

#### The Scale:

---

- 1. Do you believe that most problems will solve themselves if you just don't fool with them?
- 2. Do you believe that you can stop yourself from catching a cold?
- 3. Are some people just born lucky?
- 4. Most of the time do you feel that getting good grades mean a great deal to you?
- 5. Are you often blamed for things that just are not your fault?
- 6. Do you believe that you can stop yourself from becoming ill?
- 7. Do you feel that most of the time it doesn't pay to try hard because things never turn out right anyway?
- 8. Do you feel that if things start out well in the morning that it's going to be a good day no matter what you do?
- 9. Do you feel that most of the time parents listen to what their children have to say?
- 10. Do you believe that wishing can make good things happen?
- 11. When you get punished does it usually seem it's for no good reason at all?
- 12. Most of the time do you find it hard to change a friend's (mind) opinion?
- 13. Do you think that cheering more than helps a team to win?
- 14. Did you feel that it was nearly impossible to change your parent's mind about anything?
- 15. Do you believe that parents should allow children to make most of their own decisions?
- 16. Do you feel that when you do something wrong there's very little you can do to make it right?
- 17. Do you believe that most people are just born good at sports?
- 18. Are most of the people your age stronger than you are?

- 19. Do you feel that one of the best ways to handle most problems is just not to think about them?
- 20. Do you feel that you have a lot of choices in deciding who your friends are?
- 21. If you find a four-leaf clover, do you believe that it might bring you good luck?
- 22. Did you often feel that whether or not you did your homework had much to do with what kind of grades you got?
- 23. Do you feel that when a person your age is angry at you, there's little you can do to stop him or her?
- 24. Have you ever had a good luck charm?
- 25. Do you believe that whether or not people like you depends on how you act?
- 26. Did your parents usually help you if you asked them to?
- 27. Have you felt that when people were angry with you it was usually for no reason at all?
- 28. Most of the time, do you feel that you can change what might happen tomorrow by what you do today?
- 29. Do you believe that when bad things are going to happen they are just going to happen no matter what you try to do to stop them?
- 30. Do you think that people can get their own way if they just keep trying?
- 31. Most of the time do you find it useless to try and get your own way?
- 32. Do you feel that when good things happen they happen because of hard work?
- 33. Do you feel that when somebody your age wants to be your enemy there's little you can do to change matters?
- 34. Do you feel that it's easy to get friends to do what you want them to do?

Norms

External Score: 16-40

Internal score: 0-15

External Scorers: A score above 15 suggests that you have a fairly strong belief that events are beyond your control. In other words, you do not feel that there is much of a connection between your behavior and your outcomes. You tend to believe that success and failure are primarily a matter of luck and chance breaks.

Internal Scorers: A score below 15 indicates that you have a firm belief in your ability to influence your outcomes. Your relatively internal score means that you generally do not attribute your successes and failures to good and bad luck or chance factors. Instead, you feel that you can influence the course of what happens to you. An internal locus of control is associated with relatively great stress tolerance.