Relationship of Rated Perceived Exertion to Heart Rate and Workload in Mentally Retarded Young Adults

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This study was conducted to determine the predictive ability of rated perceived exertion (RPE) of mentally retarded (MR) young adults with respect to heart rate (HR) and workload (WL). Subjects were a group of 10 mentally retarded adults (M age = 21.20 yrs, M IQ = 50.5) and a control group of 10 nonretarded adults (M age = 21.18 yrs). The procedure involved the performance of a continuous multistage treadmill test using a modified Balke protocol. Rated perceived exertion and heart rate were recorded after each minute. Correlation coefficients for both RPE/HR and RPE/WL were significant for both groups. Tests for differences in RPE/HR and RPE/WL correlation coefficients between the two groups indicated significance for RPE/HR but none for RPE/WL. Regression analysis revealed that variation in RPE could be explained by variations in HR and WL. The association between rated perceived exertion and heart rate and rated perceived exertion and workload suggests the use of the Borg scale with mentally retarded individuals.

Borg (1970) developed a scale of rated perceived exertion (RPE) which has been used almost exclusively with athletes and highly skilled performers, especially over the past 10 years (Borg, 1982; Hochstegler, Rejeski, & Best, 1985; Pandolf, 1982; Young, Cymerman, & Pandolf, 1982). This psychophysical scale is purported to correspond linearly with exercise intensities and provides researchers with information about the central (heart rate, ventilation) and peripheral (breathlessness, sweating, muscle fatigue, lactate accumulation) sensations of physical exertion during exercise.

The Borg scale (1970) has been tested for validity and reliability (Eston & Williams, 1988; Thiel, 1986) and is now accepted as an accurate estimator of physical exertion among individuals with no limiting physical, orthopedic, health, or mental disabilities. Only recently have researchers begun using the Borg scale with persons who have disabilities (Birk & Mossing, 1988; Nystad, Oseid, & Mellbye, 1989). In fact, prior to these investigations, Borg (1982) suggested that "these methods should be equally applicable to most people regardless of gender,"
age, circumstances, and national origin’’ (p. 377). Whether Borg was suggesting that “circumstances” include persons with disabilities is not known. However, it has been demonstrated that using the RPE scale for individuals with asthma or cerebral palsy yields results similar to those of nondisabled individuals (Birk & Mossing, 1988; Nystad et al., 1989). Thus the presence of such disabilities does not preclude the ability to psychologically and physiologically sense the amount of physical exertion.

Can mentally retarded individuals also perceive physical exertion as a function of heart rate or workload in a linear fashion? Mentally retarded individuals tend to have lower physical fitness levels than their nonretarded peers (Molnar, 1978; Pitetti & Tan, 1990; Rarick, Widdop, & Broadhead, 1970; Seidl, Reid, & Montgomery, 1987; Tomporowski & Jameson, 1985; Webb & Koller, 1979). Therefore, when comparing MR and nonretarded individuals, the relative workloads between the groups may be dissimilar. However, Felts, Crouse, and Brunetz (1988) have indicated that these inequalities should not make a difference when comparing RPE to heart rate and workload.

With these issues in mind, the purpose of this study was to determine the relationship of rated perceived exertion to heart rate and workload in mentally retarded young adults.

Methods

Subjects

Ten nonretarded subjects (6 women, 4 men) and 10 mentally retarded young adults (6 women, 4 men) volunteered to participate in a submaximal, graded exercise treadmill test. The control subjects (nonretarded) ranged in age from 19.1 to 23.5 years and had a mean age of 21.2 years. The MR subjects ranged in age from 17.3 to 25.7 years, with a mean age of 21.2 years. IQ scores for the MR group ranged from 38 to 64. The mean IQ for this group was 50.5.

Instrumentation and Protocol

A Quinton 18-54 model treadmill was used for the test protocol. In addition, heart rates were measured with a Marcom Telemetry System. A two-lead configuration was affixed to each subject’s chest to detect the heart signal.

A variation of the Balke (Heyward, 1984) treadmill protocol was used for the control subjects. The protocol required that the subject maintain a steady walking pace at 3.5 mph at 0% grade of incline for the first minute, followed by a 1% grade increase every minute thereafter until completion of the test. However, following a pilot study this protocol was modified for use by the MR subjects. The walking speed began at 1.0 mph for the first minute and was then raised .5 mph each subsequent minute until the subject reached the maximum 2.5-mph speed. The grade of incline remained at 0% until the fifth minute, whereupon it was raised 2% each subsequent minute.

The Borg Scale of RPE (1970) was used to compare HR and WL equivalencies with the subjects’ estimations of perceived exertion during exercise. Following each stage (1-minute interval of walking), the subjects were asked to indicate a numeral on the Borg scale that best described their peripheral sensations of exertion from the walking activity. Subject response and heart rate were recorded.
If subjects indicated a score of 20 on the scale, or if their recorded HR was above 85% of their maximum predicted heart rate, the test was terminated. It was terminated by decreasing the grade of the treadmill to 0% and gradually slowing the speed to 1-1/2 mph while the heart rate recovered to near resting rate.

**Statistical Analysis**

Because the Borg scale was devised on the assumption that response to perceived exertion should increase linearly with increasing work effort, correlation and linear regression were employed to establish association and to determine whether the relationship between RPE and HR response can adequately be described by a linear regression of the general form \( Y = bX + a \). These analyses would determine the effectiveness of RPE in portraying both HR response and metabolic demand of actual work performance.

Pearson correlation coefficients were calculated for each of the following situations: RPE/HR (control), RPE/HR (MR), RPE/WL (control), and RPE/WL (MR). A test of significance using the distribution of \( t \) was applied to test the null hypotheses that the values of \( r \) were equal to zero. In addition, 126 pairs of RPE/HR and RPE/WL scores for the subjects in the control group were analyzed for the regressions of RPE on HR and RPE on WL. For the MR group, 103 pairs were used. ANOVA as a test of significance in regression was selected to explain the variation of the dependent variable in terms of the variation of the independent variable. In addition, RPE/HR and RPE/WL correlation coefficients between the control and MR groups were compared using Fisher's test involving \( z \)-transformation of the coefficients.

**Results**

Because of variations in fitness levels, the number of stages of the Balke test protocol completed was different, both among and between subjects and groups. For the control subjects, completion ranged from Stage 9 (3.5 mph, 8% grade) to Stage 18 (3.5 mph, 17% grade), while the MR group ranged from Stage 10 (2.5 mph and 10% grade) to Stage 13 (2.5 mph and 16% grade). Metabolic demand (in METs) based on workload, rating of RPE, and heart rate were recorded for each 1-minute interval completed by the subject. Additionally, Borg scale interpretations for both groups ranged from the minimum value of 6 through the maximum value of 20.

Association between RPE and each of the independent variables, heart rate and workload, was significant. For RPE and HR, correlation coefficients of .82 for the control subjects and .65 for the MR subjects resulted in significance at the .01 level. In evaluating RPE and WL, the correlation coefficients for the same groups were .87 and .81, respectively. Both coefficients were significant (\( p < .01 \)) as well.

Figures 1 and 2 show the linear regressions of RPE on HR fitted to data for the control and MR groups, respectively. For each subject group, the regression of RPE on HR was found to be highly predictable. The amount of linear variation in RPE accounted for by variation of HR was measured and a significant relationship between RPE and HR was observed for the control group (\( F = 258.86, p < .01 \)). Similar results appeared for the MR group (\( F = 75.48, p < .01 \)). The regression of RPE on WL (Figures 3 and 4) resulted in similarly significant...
Figure 1 — Regression of RPE on HR for control group.

Figure 2 — Regression of RPE on HR for MR group.

values for the control group ($F = 418.74, p<.01$) and the MR group ($F = 196.61, p<.01$). These results strongly suggest that variation of RPE could be explained because of variation in WL.

Standard error for sampled mean of RPE at mean HR proved low: .19 for the control group and .31 for the MR group. Likewise, low standard errors for
sampled mean of RPE at mean WL were found for the control and MR groups (.16 and .24, respectively).

Treating the two groups as independent samples, differences between their correlation coefficients for RPE/HR and RPE/WL were examined using Fisher’s z-transformation. The correlation coefficients for RPE/HR for the two groups did
prove to be significantly different from one another. Transformed scores of 1.157 and .775 were derived from the coefficients .82 and .65, respectively (z = 2.85, p<.01). However, for the correlations RPE/WL, no significant difference was determined between the two groups.

Discussion

Based on the results of this study, the ability of mentally retarded young adults to perceive accurately submaximal levels of physical exertion with respect to their heart rates is equivalent to that of their nonretarded peers. Similarly, when comparing RPE to the actual workload, there were no differences between MR and the nonretarded young adults in their ability to perceive accurately the work demands.

Although persons with mental retardation were as capable as their nonretarded counterparts in rating perceived physical exertion and workload intensity, the MR group was slightly more variable in their interpretations than the control group. This is especially true for RPE versus HR, as seen by the correlation coefficients (r = .82 for control group and r = .65 for MR group) and by the greater standard error measures for the MR group.

The Borg scale has previously been demonstrated to be a useful field-based device to measure perception of exercise by individuals who range from being physically and neurologically impaired to those who are active and nonimpaired. Now it appears that the boundaries for its use have been expanded to include an even larger portion of the population, that is, for persons classified as being mentally retarded.

According to the results of this study and based on heart rate values, mentally retarded young adults are capable of interpreting physical exertion between the thresholds of “very, very light” exercise, which theoretically corresponds to a heart rate of 60 bpm on the Borg scale, up to intensities regarded as “hard” and “very hard” (150–165 bpm). It should also be noted that reported RPE values ranged from the lowest value, 6, up to and including the highest value, 20, for both the control and the MR group. This indicates that one or more of the subjects from each group perceived exercise, which was limited to 85% of maximum estimated heart rate, at a level of maximal intensity (a score of 20 on the Borg scale).

The results of this study would suggest to the practitioner that the ability of mentally retarded individuals to monitor submaximal exercise intensities and to relate those feelings is commensurate to that of their nonretarded counterparts. Teachers, coaches (e.g., Special Olympics programs), and others who work regularly in the motor domain with mentally retarded individuals should acknowledge and respond appropriately to these expressions of exertion.

References


