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Reinforcing Value of Interval and Continuous Physical Activity In Children

Jacob E. Barkley, Ph.D.[1,2], **Leonard H. Epstein, Ph.D.**[1,3], and **James N. Roemmich, Ph.D.**[1,2]

[1]Department of Pediatrics, School of Medicine and Biomedical Sciences, University at Buffalo, Buffalo, New York 14214, USA

[2]Department of Exercise and Nutrition Sciences, University at Buffalo, Buffalo, New York 14214, USA

[3]Department of Social and Preventive Medicine, School of Public Health, University at Buffalo, Buffalo, New York 14214, USA

Introduction

Observation of children at play demonstrates that they are active in bursts lasting several seconds followed by a period of less intense activity or rest and then another bout of activity [1-3], much like interval training. Ninety-five percent of these bouts are no longer than 15 seconds in duration [2]. While it is not clear why children naturally participate in short bouts of physical activity, it may be due, in part, to differences in the reinforcing value of interval-like physical activity compared to continuous constant intensity physical activity. Following Premack's probability-differential hypothesis an activity engaged in at a high-rate during a free-choice setting is considered to be reinforcing [4,5], which suggests that during free-play children perform short bouts of physical activity because they are more reinforcing than continuous constant intensity physical activity.

One would expect that children would be more motivated to participate in activities that they find reinforcing [6]. Reinforcement represents motivational processes that can increase the likelihood of engaging in a particular behavior. While access to a behavior also influences what type of behavior will be chosen, individuals will engage in greater amounts of the most reinforcing behavior in an observational situation where all choices are equally accessible [4, 5]. In experimental behavioral choice situations individuals are motivated to work harder to gain access to more reinforcing behaviors [6,7]. The reinforcing value of one behavior relative to another behavior (RRV) can be measured as the amount of motivated responding (work) an individual will engage in to earn access to one of two behaviors [8-10]. If one behavior is more reinforcing relative to an alternative behavior, an individual will have greater motivation to respond to gain access to the more reinforcing behavior. The validity of this approach to assess the motivation to engage in physical activity has been demonstrated by showing that those children who have a greater RRV of physical activity to sedentary behaviors participate in greater amounts of total free-living physical activity [1] and moderate-to-vigorous physical activity [11]. While individual differences in the RRV of various physical activities to sedentary behaviors have been investigated, the basic parameters of physical activity such as the pattern

Address for correspondence and reprint requests: Jacob E. Barkley, Ph.D, Kent State University, School of Exercise Leisure and Sport, e-mail: E-mail: jbarkle1@kent.edu, 163E MAC Annex, Kent, OH, 4424, USA, Phone: (330) 672-0209, FAX: (330) 672-2250.

(e.g., interval or continuous constant load) or intensity that makes an activity more or less reinforcing have not yet been studied. Understanding differences in the reinforcing value of various patterns and intensities of physical activity has important considerations for the conceptualization and development of physical activity programs that children will be the most motivated to regularly participate in. The potentially greater reinforcing value of interval physical activity may be due to children's physiology [12]. Children, relative to adults, exhibit smaller muscle mass, lower muscle concentrations of glycolytic enzymes and stored glycogen, greater phosphocreatine resynthesis, quicker recovery time and reduced hydrogen concentrations [13-17]. These unique characteristics of muscle metabolism increase a child's ability to perform repeated bouts of short duration, high-intensity physical activity while limiting their ability to perform continuous physical activity at intensities that exceed the lactate threshold or the ventilatory threshold (VT) [18,19] which is valid predictor of the lactate threshold in children. Conversely because children do not have deficiencies in aerobic metabolism [20-22] their unique muscle metabolism would likely not favor interval or continuous physical activity at intensities below VT.

Thus, the purpose of this study was to compare the RRV of an interval pattern of physical activity to that of a constant load continuous pattern of physical activity. The RRV of these physical activity patterns was tested both above and below the ventilatory threshold in boys and girls to determine whether children's unique muscle physiology influences the RRV of interval relative to constant load continuous physical activity. This study was designed to test three hypothesis; 1) that interval physical activity above VT is more reinforcing than interval physical activity below VT, 2) that interval physical activity is more reinforcing than continuous physical activity at intensities above VT and below VT and 3) that the amount of motivated responding children perform to gain access to interval physical activity will predict the amount of time that they allocate for interval physical activity in a free-choice setting.

Methods

Subjects

Children were prepubertal (Tanner genital stage I), normal weight (body mass index (BMI) percentile ≤ 85) boys (n = 16,) and girls (n=16), age 8-11 years. Thirty one children were Caucasian and one child was African American. Children who had a history, as reported by a parent, of any clinical disorders including orthopedic, cardiovascular, neuromotor, or cognitive disorders that would interfere with physical activity participation were excluded from this study. Additionally, children who were currently participating in planned exercise for greater than 45 minutes 3 times per week were excluded from this study as this participation could predispose children for a liking for interval physical activity as many organized physical activities for children are interval in nature (e.g., basketball, soccer, dance). Written informed parental consent and child assent were obtained for each subject prior to participation. This study was approved by the University at Buffalo Children and Youth Institutional Review Board.

Laboratory visit #1 (VO_2 Peak testing)

Children meeting the entry criteria were invited to the Behavioral Medicine Laboratory at the University at Buffalo along with a parent or legal guardian. Children were measured for height and weight, and performed a VO_2 peak/ventilatory threshold (VT) test on a cycle ergometer using an exercise protocol that produces valid measures of VT in children [18,23-26]. The initial work rate was set at 30 W min^{-1} and increased by 10 W·min^{-1} every minute until a pedal cadence of 50 revolutions·min^{-1} (RPM) could not be maintained. Indirect calorimetry (Vmax 29 Metabolic Cart, Sensormedics) was used to measure O_2 consumption and CO_2 production.

VO_2 peak was defined as the average VO_2 in $ml \cdot kg^{-1} \cdot min^{-1}$ during the last 30 seconds of the final test stage [18]. VT was determined as previously described [18,23-26].

Laboratory visits #2 and #3

For the second and third laboratory visits children returned to the Behavioral Medicine Laboratory to perform 5 minutes of interval and 5 minutes of continuous physical activity on a cycle ergometer at an intensity that was 20% below VT on one day and 5% above VT on another day. After sampling the interval and continuous physical activity protocol on each day, children completed a RRV computer task which measures the amount of work (button presses on a computer mouse) children are willing to perform for additional access to interval relative to continuous physical activity. Similar button pressing tasks have been shown to be a valid predictor of the RRV physical versus sedentary activity in children [1,11]. The visit order (above VT day, below VT day) and physical activity protocol order (interval, continuous) for each visit were counterbalanced across subjects. The physical activity protocols were matched for energy expenditure on each day as follows:

Protocol #1 - Continuous constant load cycling above VT. Children pedaled at 50 RPM for 5 minutes at a resistance that elicited a VO_2 that was 5% greater than the VO_2 at VT.

Protocol #2 - Interval cycling above VT. Children pedaled at 80 RPM for 20 seconds at a resistance that was identical to the resistance from protocol #1 then 20 seconds at 50 RPM and 0.5 kp resistance. Children repeated this pattern for 5 minutes.

Protocol #3 - Continuous constant load cycling below VT. Children pedaled at 50 RPM for 5 minutes at a resistance that was equal to the workload that elicited a HR of 140 $beats.min^{-1}$ during the VO_2 max test. Children spend a majority of their physically active time at a HR near 140 $beats.min^{-1}$ [3] and this corresponds to an intensity that is 20% below VT, on average.

Protocol #4 - Interval cycling below VT. Children pedaled at 80 RPM for 20 seconds at a resistance that was identical to the resistance from protocol #3, then 20 seconds at 50 RPM and 0.5 kp resistance. Children repeated this pattern for 5 minutes.

Laboratory Visit #4

During visit #4 children participated in a free-choice session to determine the amount of interval or continuous physical activity above and below VT that the children freely choose to engage in. Children participated in two physical activity periods, one above VT and the other below VT. Each period was 7-minutes in duration and the order was counterbalanced across subjects. At the beginning of each physical activity period children were reminded of the continuous and interval physical activity cycle ergometer protocols that they had participated in during visits two and three and instructed to perform as much continuous or interval physical activity as they wanted. Children exercised on a cycle ergometer at the same intensities used to the test the RRV of continuous to interval physical activity. The investigator recorded the time spent performing interval or continuous physical activity. Children were allowed to switch between interval and continuous physical activity whenever they wished during the 7-minute period. Once the child completed the first 7-minute period they were given a 10-minute rest period. Children then completed another 7-minute period of physical activity at the remaining intensity (above or below VT). The total time children participated in interval physical activity above and below VT during the free-choice setting was compared to the total amount of time children earned for interval physical activity above and below VT during the RRV computer task to determine if the computer task predicts a free-choice environment.

Anthropometrics

A trained anthropometrist (JB) completed all measurements. Each variable was measured 3 times and the median score was recorded. Height was measured to the nearest 0.1 cm with a stadiometer (Seca, Hamburg, Germany), and weight was measured to the nearest 0.1 kg with a calibrated electronic scale (Tanita, Arlington Heights, Illinois).

Heart rate

Heart rate was recorded every minute during each physical activity protocol (VO_2 peak test, physical activity samples, earned physical activity and free choice physical activity) and was measured using a heart rate monitor (Polar Vantage XL).

Rating of Perceived Exertion (RPE)

Undifferentiated RPE was monitored during the VO_2 peak test, physical activity sampling, earned physical activity, and free choice physical activity using the CALER RPE scale [27, 28]. The scale's use was explained with a standardized set of instructions. Perceived exertion was defined as “How tired does your body feel during exercise?” [29]. Ratings were undifferentiated as an estimate of the perceived exertion of the total body.

Ventilatory Threshold

After completing a cycle ergometer protocol previously shown to produce valid measures of lactate threshold and VT in children [18,23-26], VT was determined from plots of the ventilatory equivalent for oxygen and the ventilatory equivalent for carbon dioxide versus time. VT was identified as the workload before ventilatory equivalent for oxygen begins to increase without an increase in the ventilatory equivalent for carbon [18,23-26]. The VO_2 corresponding to VT was then determined. The plots were examined independently by three investigators with agreement required by at least two of the three individuals. This is the standard method for assessing VT in children [18,23-26]

Relative Reinforcing Value

Assessment of RRV of continuous and interval physical activity was accomplished by asking children to perform work, in the form of button presses on a computer mouse, to earn access to either interval or continuous physical activity. Children had the option to work on either of two computer screens; one screen was associated with earning points towards interval physical activity and the other with continuous physical activity. Children were told that they could work to earn points for interval or continuous activity and they could switch from working on one screen to the other as often as they wish. Each screen consisted of a series of three different shapes, when the computer mouse button was pushed the shapes would change. The goal was to have the shapes match. When the shapes matched on one screen a point was earned for the physical activity pattern associated with that screen. Each point earned was equal to one minute of physical activity for that corresponding physical activity pattern. The RRV computer task was performed until a child accumulated a total of 7 points from which they earned 7 minutes of physical activity. The reinforcement schedule for both interval and continuous physical activity was initially set to a fixed ratio 4 (children earned one point for every 4 button presses) for the first point earned. The fixed ratio level then doubled with each point earned for one task (complete fixed ratio schedule; 4, 8, 16, 32, 64, 128, 256). The fixed ratio level only increased for a physical activity pattern if a point was earned for that physical activity pattern. The schedules for the two physical activity pattern alternatives were independent in that the fixed ratio level for a specific activity pattern did not increase to the next fixed ratio level until the child had completed the necessary operant responding to earn a point for that pattern. After children accumulated a total of 7 points they were required to complete the interval and continuous physical activity they earned. Outcome measures included total number and pattern

of responses performed (amount of work) and output maximum (O_{max}) for interval and continuous physical activity. O_{max} is defined as the maximum amount of responding for one minute of interval and continuous exercise [30]

Liking of physical activity

At the conclusion of each physical activity protocol the child rated their liking of the activity by using a visual analog scale (VAS) which was a 10 cm line anchored by “like it very much” and “do not like it at all.

Data Analysis

Separate one-way ANOVA was used to examine sex differences in age, height, weight, BMI percentile, VO_2 peak, peak respiratory quotient, physical activity workloads and the percentage of maximum effort those workloads represented. Four-way ANOVA with sex (boys, girls) as a between subjects factor and physical activity pattern (interval, continuous), physical activity intensity (above VT, below VT) and fixed ratio level (fixed ratio 4, 8, 16, 32, 64, 128, 256) as within subjects factors was used to examine differences in the amount of button presses children performed during the RRV computer task. The button press data were log transformed as they were not normally distributed. Three-way ANOVA with sex (boys, girls) as a between subjects variable and physical activity intensity (>VT, <VT) and physical activity pattern (interval, continuous) as within subject's variables was performed to compare the average O_{max} for interval and continuous exercise determined via the RRV computer task. The same three-way ANOVA model was also used to examine differences in CALER RPE and liking scores for each five minute physical activity sample. Significant interactions for all ANOVAs were explored using contrast statements. Linear regression analyses were performed to determine if CALER RPE and liking scores for interval and continuous exercise were independently associated with the total number of button presses performed for interval and continuous physical activity above and below VT. Univariate correlation analysis were performed to determine the relationship between the time children earned for interval physical activity, above and below VT, while playing the RRV computer task and the proportion of time children freely choose to perform interval physical activity above and below VT during the free-choice session.

Statistical power analyses were performed for the two primary hypotheses: 1) that interval physical activity above VT is more reinforcing than interval physical activity below VT, 2) that interval physical activity is more reinforcing than continuous physical activity at intensities above and below VT. O_{max} for interval physical activity above and below VT was 92.5 ± 87.9 presses and 75.5±99.4 presses respectively. The difference between these values yielded an effect size of 0.17, which required 266 pairs of participants to achieve a statistical power of ≥ 0.80 at an α level of < 0.05. Because of the large number of participants required to achieve statistical power for this comparison it was determined that no difference existed for O_{max} between interval physical activity above and below VT. Average O_{max} for interval physical activity and continuous physical activity was 84.0 ± 93.7 presses and 29.3 ± 53.8 presses respectively. This difference yielded an effect size of 0.73, which required 17 pairs of participants to achieve a statistical power of ≥ 0.80 at an α level of < 0.05. Thus the current sample size (N = 32) was more than adequate to demonstrate this effect.

Results

Physical characteristics and exercise test results of the children are shown in Table 1. The boys and girls did not differ ($P \geq 0.10$) for chronological age, height, weight, or BMI percentile. Boys had a greater ($P < 0.05$) VO_2 peak than girls, but did not differ ($P \geq 0.22$) for peak

respiratory quotient, VT, the workloads used above and below VT during the physical activity sample days or the percentage of maximum effort those workloads represented.

Differences in the number of button presses across the 7 fixed ratio levels (fixed ratio 4, 8, 16, 32, 64, 128, 256) for interval and continuous physical activity, above VT and below VT are shown in the Figure. The four-way ANOVA demonstrated a significant fixed ratio level by physical activity pattern interaction ($P < 0.001$). Post-hoc analyses revealed that children performed a greater number of button presses to gain access to interval physical activity compared to continuous physical activity at fixed ratio levels 8 ($P < 0.01$), 16 ($P < 0.001$), 32 ($P < 0.001$), 64 ($P < 0.001$), 128 ($P \geq 0.01$), but not ($P \geq 0.16$) at fixed ratio 4 or 256 for physical activity intensities above VT. For physical activity intensities below VT children performed a greater number of button presses to gain access to interval physical activity compared to continuous physical activity at fixed ratio 128 ($P < 0.02$) and fixed ratio 256 ($P < 0.03$), but not ($P \geq 0.11$) at fixed ratio 4, 8, 16, 32 or 64. The greater number of presses for interval physical activity across various fixed ratio levels resulted in a significant main effect of physical activity pattern ($P < 0.005$) with children performing a greater overall number of presses for interval than continuous physical activity. By design, there was a main effect of fixed ratio level ($P < 0.001$) as children increased the number of responses for both interval and continuous physical activity from fixed ratio 4 to 8, 8 to 16 and 16 to 32 above VT and from fixed ratio 4 to 8, 8 to 16, 16 to 32 and 128 to 256 below VT. There were no additional significant two ($P \geq 0.39$) or three way ($P \geq 0.09$) interaction effects for exercise pattern, or fixed ratio level nor were there any significant main or interaction effects for sex ($P \geq 0.47$) or physical activity intensity ($P \geq 0.09$) in the number of responses children performed.

In addition to differences in the response pattern for interval and continuous physical activity, separate 3-way ANOVA analysis demonstrated a significant main effect of physical activity pattern (interval, continuous) for O_{max} ($P < 0.005$,Table 2). This was due to a greater O_{max} for interval relative to continuous physical activity. There were no main or interaction effects of gender and exercise intensity ($P \geq 0.40$).

There were significant physical activity intensity by physical activity pattern interactions for CALER RPE ($P < 0.001$) and liking VAS scores ($P < 0.004$) (Table 3). Post-hoc analysis revealed that RPE was lower ($P < 0.001$) and liking was greater ($P < 0.001$) for interval physical activity compared to continuous physical activity above, but not below, VT. Additionally, CALER RPE was lower ($P < 0.01$) and liking VAS scores were greater ($P < 0.03$) for physical activity below VT compared to physical activity above VT.

Linear regression analyses demonstrated that, as RPE increased ($\beta = 37.0$, $P < 0.05$) and liking decreased ($\beta = -34.9$, $P < 0.001$) for continuous physical activity, children performed more button presses for interval physical activity above VT independent of liking and RPE for interval physical activity. The number of responses performed for above VT continuous physical activity was positively associated ($\beta = 14.0$, $P < 0.05$) with liking (measured via VAS) for continuous physical activity and negatively associated ($\beta = -28.5$, $P < 0.001$) with VAS scores for interval physical activity independent of RPE for interval and continuous physical activity. The number of responses performed for below VT interval physical activity was positively associated ($\beta = 46.1$, $P < 0.003$) with VAS for interval physical activity and negatively associated ($\beta = -44.9$, $P < 0.001$) with VAS for continuous physical activity independent of RPE for interval and continuous physical activity. Neither liking nor RPE were significantly associated ($P \geq 0.16$) with continuous physical activity below VT.

Univariate correlation analysis revealed that interval minutes earned were positively correlated to the number of interval minutes performed for physical activity above VT for girls ($r = 0.62$, $P < 0.01$) and boys ($r = 0.57$, $P < 0.02$) individually and all subjects combined ($r = 0.58$, $P <$

0.001). Interval minutes earned were positively correlated to the number of interval minutes performed for physical activity below VT for girls ($r = 0.60$, $P < 0.02$) but not boys ($r = -0.39$, $P \geq 0.14$) or all subjects combined ($r = 0.09$, $P \geq 0.60$).

Discussion

It was hypothesized that children would find interval physical activity relatively more reinforcing than constant load continuous above VT than below VT because children are metabolically limited in their ability to perform continuous exercise above but not below VT [17,20-22,31-33]. However, children performed more responding and exhibited a greater O_{max} for interval relative to continuous physical activity both above and below VT and there were no differences in the total number of button presses performed or O_{max} for interval physical activity between exercise intensities. Children's unique muscle metabolism only limits their ability to perform continuous physical activity at intensities above VT, not below VT [17,31-33] and children found interval exercise equally reinforcing above and below VT. Thus, it seems unlikely that children's immature anaerobic muscle metabolism is the sole reason for why interval physical activity is more reinforcing than continuous physical activity. Future research in late adolescents and adults, who have more mature anaerobic muscle metabolism systems, would help determine the role of muscle maturity on the reinforcing value of interval-type physical activity.

Other reasons that children found interval physical activity more reinforcing than constant load continuous activity include differences in RPE and liking of the two activity patterns. Children assigned greater RPE scores to continuous than to interval physical activity above VT. These greater RPE scores for continuous physical activity were associated with an increase in RRV of interval physical activity. Below VT, there were no significant relationships between RPE scores and RRV. Children also reported greater liking for interval than continuous physical activity when exercising above VT and liking was positively associated with RRV of interval and continuous physical activity at this intensity. While the below VT liking scores for continuous physical activity were not different from interval physical activity, the liking scores for continuous and interval physical activity were negatively and positively related, respectively, to motivated responding for interval physical activity. This suggests that lower liking scores for below VT continuous physical activity were associated with a greater amount of work performed for the alternative option; interval physical activity. Additionally, the greater the liking scores for interval physical activity below VT the more work children performed to gain access to that pattern of physical activity. RPE was significantly associated with RRV of physical activity above but not below VT so it is possible that at lower physical activity intensities liking has a greater importance in the decision-making process and, at higher intensities, other factors, such as perceived exertion, also contribute to which type of activity is more reinforcing. This is not surprising as children are likely to perceive continuous constant load physical activity as requiring more effort than interval physical activity since they are less suited for performing continuous physical activity above VT. Conversely, children are well suited to perform both interval and continuous physical activity when exercising below VT making it likely that neither exercise pattern is perceived to be very difficult which may negate the influence RPE has on the exercise pattern preference at this intensity.

Additional factors that were not measured in the present study may have also influenced children's preference for interval relative to continuous physical activity. One potential factor may be the greater variety the interval condition offers. By altering the physical activity load and the pedaling cadence the interval physical activity protocol offered greater variety than the continuous protocol. Increasing variety, such as the taste and texture of foods offered in a meal [34-38], increases eating behavior. Perhaps the increased variety of the interval physical activity protocol increased its reinforcing value.

The decision to examine the RRV of interval versus continuous physical activity was based on observational studies that indicated children predominantly perform short bouts of physical activity for a duration of their choosing [1-3]. In order to control for energy expenditure and activity duration in the present study, a scripted exercise protocol was used for both interval and continuous physical activity. Although forcing children to do a predetermined interval physical activity protocol may have reduced the RRV of interval physical activity, the RRV computer task predicted free choice physical activity patterns for boys and girls above VT and girls below VT. The RRV task also required that the children participate in activities that can be administered in a laboratory setting. This limits the physical activity options and forces the use of physical activities that may not be as reinforcing as what a child would perform in a less controlled outdoor environment (i.e. playing soccer). However, even if the interval protocol was not as reinforcing as a child's natural activity pattern, it was more reinforcing than the continuous protocol and these results agree with the natural physical activity pattern. Finally, there are limitations of generalization based on ethnicity of subjects as all but one of the subjects was Caucasian.

In conclusion, this was the first study to examine the RRV of two different patterns of the same physical activity. Children found interval physical activity more reinforcing than continuous physical activity when exercising above and below VT. Below VT intensities represents the physical activity intensities at which children complete most of their physically active play. The number of minutes earned for interval physical activity during the computer task was positively correlated to the amount of time boys and girls chose to perform interval physical activity above VT and girls only below VT. Future research examining the ability of the RRV task to predict free choice exercise patterns in boys and girls may clarify this result. Future research should seek to further examine the potential positive effect that manipulation of activity choices based on liking and RPE may have on the amount of physical activity children participate in. Another potential future direction would be examining if the results of this study would be similar in children who differ in other variables that are related to physical activity such as body weight and socioeconomic status.

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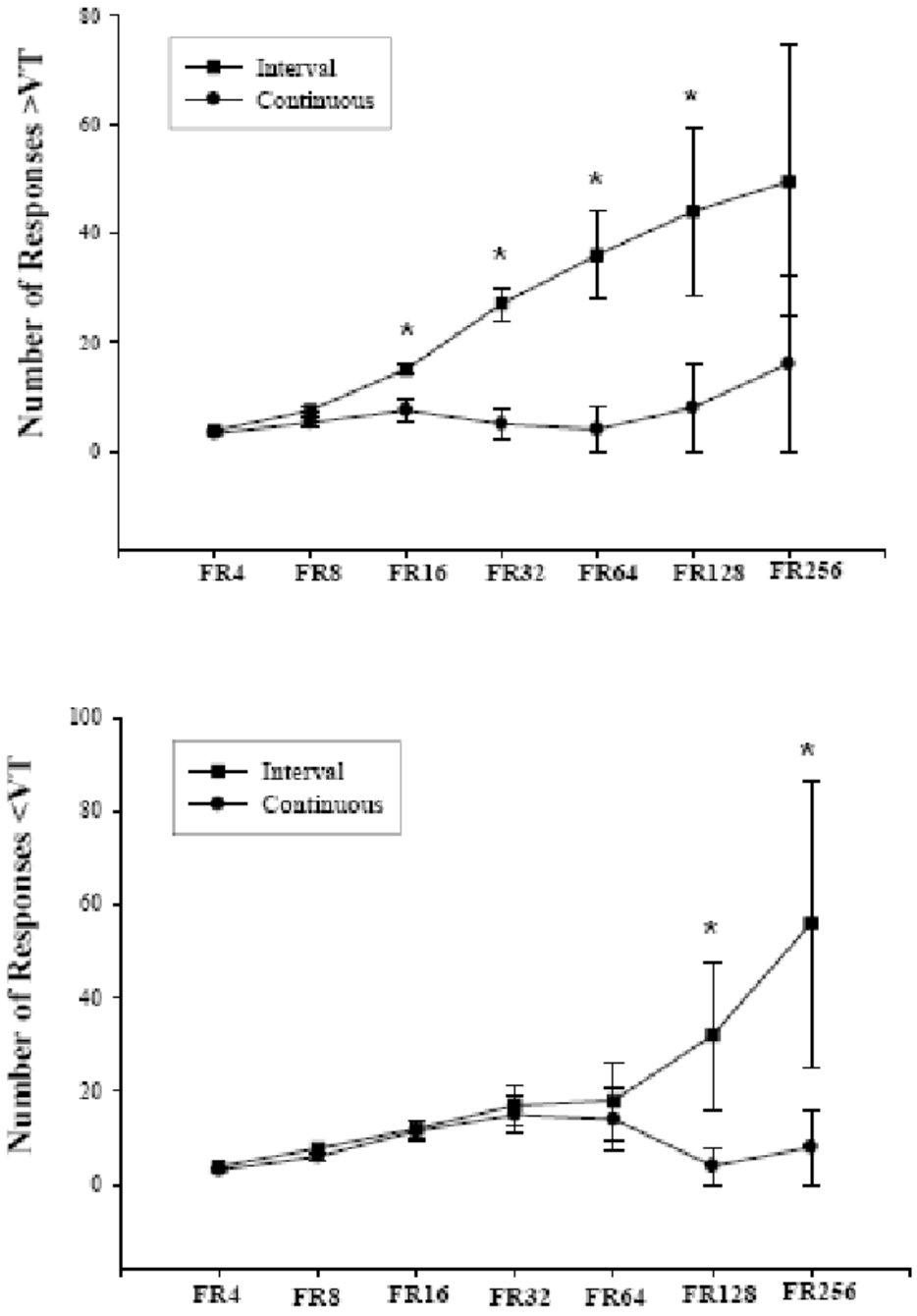

Figure.

Response patterns across the seven fixed ratio (FR) levels to gain access to interval and continuous physical activity performed above (top panel) and then below (bottom panel) the ventilatory threshold (VT). Data presented are non-transformed means ± SE. Data from boys and girls were combined because there were no significant sex differences.

*Number of responses for interval physical activity was greater ($P < 0.01$ for all) than continuous physical activity for the given FR level

Table 1

Subject physical characteristics and exercise test results

	Boys (n = 16)	Girls (n = 16)
Age (years)	9.5±0.7	9.5±0.7
Height (cm)	141.3±6.4	137.7±5.7
Weight (kg)	33.3±4.4	32.7±5.3
BMI percentile	46.7±5.0	52.4±6.1
VO_2 peak ($ml \cdot kg^{-1} \cdot min^{-1}$)*	40.8±10.9	34.9±3.3
Peak RQ	1.0±0.1	1.0±0.1
VT (% VO_2 peak)	76.7±9.0	76.8±8.6
Workload>VT (kp)	1.7±0.4	1.5±0.2
Workload<VT (kp)	1.1±0.3	1.0±0.3
Workload>VT (% max)	57.7±8.4	60.2±6.6
Workload<VT (% max)	91.9±9.1	91.5±10.4

All data are means ± SD

*VO_2 peak greater in boys than girls ($P < 0.05$)

Table 2

O_{max} for interval and continuous exercise patterns performed above and below the ventilatory threshold

	Interval physical activity	Continuous physical activity
>VT intensity (presses)	92.5±87.9	26.1±61.0
<VT intensity (presses)	75.5±99.4	32.4±46.5

All data are means ± SD

VT: ventilatory threshold

Main effect of physical activity pattern (interval, continuous, $P < 0.005$).

Data from boys and girls were combined because there were no significant sex differences.

Table 3

Liking; and perceived exertion scores during interval and continuous physical activity performed above and below the ventilatory threshold

	Boys				Girls			
	>VT		<VT		>VT		<VT	
	Interval	Cont.	Interval	Cont.	Interval	Cont.	Interval	Cont.
VAS (cm)[*,†]	5.2±2.8	4.1±2.6	6.6±2.5	6.5±3.5	5.9±2.3	3.8±2.7	6.0±2.8	6.4±2.7
CALER RPE[*,†]	3.0±1.6	3.9±2.2	2.7±1.9	3.1±2.3	2.9±2.0	4.2±2.1	2.5±1.8	2.6±1.9

All data are means ± SD

VT: ventilatory threshold

VAS: visual analog scale

RPE: rating of perceived exertion

[*] Intersity by physical activity pattern interaction ($P < 0.004$)

[†] Main effect for physical activity intensity ($P < 0.005$)