INTRODUCTION
Crank angular velocity (i.e. pedaling rate) is known to influence maximal cycling power. Instantaneous crank angular velocity within a cycle is somewhat variable for circular chainrings [4]. Noncircular chainrings (variable radius) are intended to manipulate instantaneous crank angular velocity within the cycle. Because instantaneous power varies within the cycle, manipulating instantaneous crank angular velocity may provide a strategy for optimizing maximal power. Previous investigators have evaluated the effects of chainring shape by measuring several physiological responses during submaximal cycling (e.g., oxygen consumption, heart rate) [1]. Recently, Rankin and Neptune [5] performed a theoretical analysis of noncircular chainrings and maximum cycling power but to our knowledge, the extent to which noncircular chainrings influence actual maximal power has not been reported. Thus, the purpose of this investigation was to compare maximum power produced using circular and noncircular chainrings.

METHODS
Seven trained cyclists participated in this investigation (age=27±8yrs, mass=80±10kg; height=177±7cm). Each participant performed a total of six maximal cycling trials consisting of three consecutive trials on circular chainrings and three consecutive trials on noncircular chainrings. All trials were performed on a modified Monark cycling ergometer. Specifically, the ergometer was fitted with a 53 tooth circular chainring and a 53 tooth noncircular chainring. Noncircular chainrings were mounted according to the manufacturer’s recommendations so that the maximum offset occurred when the crank was at 108 degrees. This offset is 18 degrees past maximum power which occurs at 90 degrees as reported by Martin and Brown [3]. The ergometer was also fitted with a chain guard that covered the chainrings so that participants could not see which chainring they were using. Before each set of three trials, participants were given a standard 5 minute warm-up (100-125watts). The order of the consecutive chainring trials was presented in a counterbalanced fashion. After both chainrings were tested, each participant was asked to guess the order in which the chainrings were used. Maximal power was determined across a range of pedaling rates using the inertial load method [2]. Changes in power between circular and noncircular trials were compared using a paired t-test (alpha=0.05). Data analysis was performed using Microsoft Excel (ver. 2003).

RESULTS
Participants produced 1189±53 and 1170±52 watts using the circular and noncircular chainrings, respectively (Figure 1). A paired t-test indicated that these values were not significantly different (p>0.05).

DISCUSSION
These data indicate that noncircular chainrings do not increase maximum power during cycling. This result is consistent with Hall’s work that noncircular chainrings do not alter submaximal cycling performance [1]. Although noncircular chainrings may alter crank angular velocities, two possible phenomena may offset the difference. Previous investigators have reported that cyclists exploit redundant degrees of freedom in the cycling action to manipulate joint angular velocity trajectories [3]. Thus, cyclists’ actions first, follow some preferred trajectory and second, are not constrained purely by crank angular velocity. If joint angular velocity trajectory were strictly prescribed by crank angular velocity, then noncircular chainrings would impose altered joint angular velocity trajectories. However, because redundant degrees of freedom are available to cyclists, they are free to adopt their preferred cycling motion. Specifically, they may revert back to their original cycling motion which would explain why noncircular chainrings do not produce a significant difference in cycling power. Our next step is to compare joint kinematics and biomechanical joint powers (ankle, knee, hip) between circular and noncircular chainrings.

REFERENCES