Persistent Focal Behavior and Physical Activity Performance

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Abstract

This paper examines the proclivity and performance attributes of focal students across time and activities using data from 9,345 students. Three systematic focal behavior partitions are examined: across activities, across time, and across activities and time. A student's performance is focal if it ends in 0 or 5 for push-ups and 0 for curl-ups. Chi-square tests confirm that individual focal outcomes and systematic focal outcomes occur more frequently than random processes would suggest. In each instance, the only cell that is less populated than random processes would suggest is the one that exhibits no systematic focal behavior and the cell that exhibits the greatest deviation from expected is the full focal cell. Focal students outperform their peers on three activities at two assessments. Students with 2 systematically focal outcomes have superior performance to students with no systematic focal outcomes but inferior performance to those with three or four focal outcomes.

INTRODUCTION

In game theory, a focal point is a point achieved in a negotiation process due to its prominence and, more importantly, due to its lack of ambiguity (Schelling, 1960). In negotiations involving numerical magnitudes, the solution will often end up at a mathematically simplistic solution (Schelling, 1960). The current situation is different in that the outcomes examined in this study, physical activity performance scores, are not the result of a negotiation process between parties but rather the result of individual action. Nonetheless, the result is the same gravitation toward numerically simplistic solutions, at least for some students.

This gravitation toward numerically simplistic solutions has roots in early childhood. There are a variety of reasons why five appears to be a particularly easy counting ending. Finger patterns play an important role in developing arithmetic skills (Marton, 1992). Children initially learn to count via finger counting, but "finger counting goes even farther, as it allows the children to infer the base-10 mathematical system" (Andres, Di Luca, & Pesenti, 2008, p. 642).

Because 10 has 2 and 5 as factors, skip counting by 2 and 5 employs five or two 1s digit solutions (2, 4, 6, 8, 0 and 5, 0), respectively. By contrast, skip counting by other single digit numbers requires learning sequences in which all 10 digits are employed prior to 1s digit pattern repetition. This is likely why the error rate for multiplication by five is lower than other operands (Baroody, 1985; Mulligan & Mitchelmore, 1997). Researchers have found that the average response time for single digit multiplication by five is even faster than multiplication by two (Campbell & Graham, 1985). Counting by fives is also reinforced by counting techniques taught in elementary grades. Children are taught to use tally marks in groups of five to facilitate accurate counting. A group of five tally marks have the fifth mark crossing the other four and can be viewed as the hand with the thumb folded (Marton, 1992).

Erfle and Gelbaugh (2013) examined a regular irregularity in physical activity performance histograms for curl-ups and push-ups from a sample of more than 9,000 middle-school students. These histograms showed periodic spikes at 5 and 10 unit intervals. Students who end up at these focal outcomes appear to be differentially motivated towards physical activity performance; students who exhibited systematic focal behavior across these activities achieved higher levels of physical activity performance than their non-focal peers (Erfle & Gelbaugh, 2013). The present paper examines what happens when focal behavior persists across time as well as across activities.

Student motivation for active participation in physical education decreases and students have displayed increasingly lower levels of persistence and effort in physical activity especially over the middle school years (Gao & Newton, 2009). Persistence and effort, as key antecedents to motivation, are among the criteria researchers use to assess motivation in sport and physical education (Gao & Newton, 2009). The hypothesis of the present study asserts that being persistently focal across time is an indicator of motivation in a fitness activity.

Effortful persistence, defined as "self-perceptions of continued investment and overall amount of time, energy, or work expended on a task or goal," is important for achievement or attainment of challenging or long-term goals (Liew, Xiang, Johnson, & Oi-Man Kwok, 2011) . Effortful persistence has been shown to predict performance in physical fitness testing, particularly in the one mile run (Liew et al., 2011), one of the physical activity tests in this study. Additionally, persistence predicts one's ability to complete tasks and achieve goals (Gao, Lee, Xiang, & Kosma, 2011). Those who demonstrate persistence in an activity tend to compare their performances with personal standards, performing to the best of their abilities in that activity (Martinek & Williams, 1997).

The behavioral qualities associated with persistent individuals—having a mastery-approach, a performance-approach, intrinsic motivation, and identified regulation (Gao, Podlog, & Harrison, 2012), align with those identified for students who were focal across activities (Erfle & Gelbaugh, 2013). We expect to observe effects of the focal across time classification similar to those with the focal across activities classification.

METHOD

Participants

The Pennsylvania Department of Health (PADoH) instituted the Active Schools Program (ASP) to encourage daily physical activity among middle-school students. Participating schools agreed to institute a regimen of daily physical education and to assess physical fitness and weight status at the start and end of the academic year. The Robert Wood Johnson Foundation funded a control school analysis of the ASP program through Active Living Research Rapid Response Grant #68311. Control schools administered the ASP assessment protocol at the start and end of the academic year but otherwise maintained their regimen of non-daily physical education. The ASP reporting template for the spring assessment did not include performance information from the fall. As a result, students had no point of reference, other than their memory, of how they performed in the fall assessment. The combined ASP and control schools data set had 10,206 students (6,693 ASP, 3,513 control) from 39 schools (30 ASP, 9 control) with complete fall and spring information. The present analysis is restricted to the 9,345 students (6,216 ASP, 3,129 control) who performed at least one curl-up and one push-up for the fall and spring assessments. This protocol has received Institutional Review Board approval.

Procedure

Given two activities (curl-ups, *c*, and push-ups, *p*) and two assessment times (fall, *f*, and spring, *s*), there are four events where a student may achieve a focal outcome (*cf, pf, cs,* and *ps*). Because each student can be focal or not focal on each activity at each time, each student's four performances can be described as having one of sixteen possible focal outcomes (16 = [focal or not focal] × 4 Events = 2^4). Not all of these outcomes involve systematic focal performances; some involve a single focal performance (pf, cf, ps, and cs), or two focal performances with one focal activity in the fall and the other in the spring (pfcs and cfps). On the assumption that systematic behavior exhibits greater intentionality than non-systematic behavior, this paper focuses on various forms of systematic focal behavior.

Systematic focal behavior across activities and across time. Performance scores can be systematically focal for a single activity across time or for multiple activities at a single time. Define a student as *Full* focal if the student is focal for all four events. If a student is focal at less than four events, that student may exhibit systematic behavior across activities for a single time or across time for a single activity. This produces 2 four-cell partitions of students according to focal behavior, one across activities (*AA*) the other across time (*AT*).

A 10-cell cross-classification partition of systematic focal behavior. The 2 four-cell focal partitions form the basis for an alternative partition of systematic focal behavior. The intersection of these partitions, $AA \cap AT$, is its own 10-cell cross-classification partition of systematic focal behavior.

Chi-square tests were used to test for independence across cells. Pairwise comparisons of column proportions for a given row utilized the Bonferroni adjustment method for multiple comparisons. The performance characteristics of students in each of these partitions were examined using difference between means tests. Excel was used for data screening and SPSS

(IBM SPSS Statistics 20) was used for statistical tests. A 5% significance level was used for all tests.

RESULTS

The average number of curl-ups (36.1 in the fall and 40.8 in the spring) is more than twice as large as the average number of push-ups (15.3 in the fall and 18.4 in the spring). By defining focal scores for push-ups in multiples of five and curl-ups in multiples of ten, each activity has three to four focal outcomes below the mean activity level. Given this, an individual push-up performance is focal if it is a multiple of five and an individual curl-up performance is focal if it is a multiple of ten. This allows the average student to have approximately the same number of chances of stopping at a focal outcome for both activities.

Focal proclivity across individual events, AA, AT, and AA∩AT

If a student's choice of number ending were random, then one would expect each of the digits would occur with frequency $f_e = .1$; a focal push-up performance would occur with expected frequency $f_e = .2$ (last digit 0 or 5) and a focal curl-up performance would occur with expected frequency $f_e = .1$ (last digit 0). Each of the $2^4 = 16$ possible outcomes (focal or not focal on each of four events) is shown in Table 1 from four perspectives. In Panel *a*, each cell includes three components: a name, the actual cell count, and a standardized residual based on independence across events. The $\chi^2 = 5875$, $p < .001$ allows us to reject the hypothesis of independence across events. The expected value for each cell is obtained by multiplying row and column expected frequencies and multiplying the 9345. For example, if focal proclivity were random, the *Full* focal cell is $f_e = .0004$ ($.0004 = .2 \times .1 \times .2 \times .1$). These 86 students are far more than the 3.7 one would expect based on random focal proclivity ($3.7 = .0004 \times 9345$). The

standardized residual for this cell confirms that this cell is the most important contributor to chi-square with more than 30% of chi-square based on this assumption (.308 = 42.5^2/5875).

**** Table 1 about here ****

Rows and columns are organized by time in Panel *b*, and by activity in Panels *c* and *d*. Each of these three panels includes an additional element, subscripted letters after each cell count indicating which pairs of column proportions are significantly different for a given row. In Panel *b*, this allows one to examine whether spring focal behavior varies as a function of fall focal behavior. In Panel *c* this allows one to examine whether curl-up focal behavior varies as a function of push-up focal behavior and in *d* the reverse is examined.

Both chi-square tests allow us to reject independence across time and across activities but the chi-square in Panel *b* is higher suggesting that proclivity differences are stronger across time than across activities. In both orientations, *Full* has the largest standardized residual and a contribution to chi-square exceeding 25%. In Panel *b*, the two largest negative standardized residuals are for 2F and 2S. If a student is focal across activities for a single time period, it is less likely that the student will fail to be focal on both events in the other time period. Similarly, in Panels *c* and *d*, students who are focal on one activity across time but not on the other activity are less likely than expected according to the standardized residuals of -3.2 in 2C and -2.1 in 2P. Interestingly, the only row in which all four cells are not significantly different from one another is for those who were focal on push-ups in the spring but not the fall in Panel *c*.

Seven of the cells in Table 1 depict non-systematic forms of focal behavior. The cell *None* has no focal events, four of the cells are individual focal events (but not the other three) two are focal for one activity in the fall and the other in the spring. These seven cells are

combined in Table 2 as *Not*. The other nine cells in both tables exhibit systematic focal behavior either AA, or AT, or both.

**** Table 2 about here ****

Chi-square tests reject independence AA, AT and AA∩AT. For each systematic partition, the only cell with actual membership below expected membership is the one with no systematic focal behavior (*Not AA*, *Not AT*, and *Not*). *Full* is the most important contributor to chi-square for each partition. More than 45% of the deviation between actual and expected is explained in both of the four cell partitions and 34.9% of the deviation between actual and expected is explained in the 10-cell cross-classification system by *Full*. The AA partition examined in the right hand column of Table 2 is the form of systematic focal behavior examined by Erfle and Gelbaugh (2013). One of their results was that focal membership increased from grade to grade. As a result, it is not surprising that focal proclivity increases from F¬S to S¬F because students are older in the spring assessment than in the fall.

Focal performance AA and AT

Figure 1 examines the relative performance of both four-cell partitions for each activity for both times. Twelve relative comparisons are shown (3 Activities × 2 Times × 2 Partitions). Cell mean with 95% confidence interval (CI) on mean are shown via whisker plots with *p* values of difference between means tests for each comparison.

The twelve relative comparisons in Figure 1 show consistent systematic relative performance patterns. *Full* focal students have superior performance in each of the 12 comparisons, five of which are significantly different from the other three cells. All five of the comparisons in which *Full* is significantly better than the other three are fall assessments. At the opposite end of the focal performance spectrum, all six of the *Not* AA mean performances are

significantly worse than the other three cells in their respective Activity × Time cells. The same is true for *Not* AT students for curl-ups and mile run. Push-up performance by *Not* AT students is not significantly different from C¬P students in Panel *b*. Indeed, the same can be said on the high performance side for this activity: P¬C students are not significantly different in their push-up performance from *Full* focal students. These results suggest a performance asymmetry between those who are focal on push-ups and those who are focal on curl-ups.

**** Figure 1 about here ****

For those involved with intermediate levels of systematic focal behavior AA, higher performance occurs in the focal period than in the non-focal period. Across activities, mean fall performance is higher for F¬S than S¬F but mean spring performance is higher for S¬F than F¬S. Two of these differences are statistically significant: spring curl-ups and spring push-ups. In general, the differences are more pronounced for push-ups and curl-ups than for mile run.

For those involved with intermediate levels of systematic focal behavior AT, higher performance occurs on the activity that is focal than on the non-focal activity. For both times, mean curl-up performance is higher for C¬P than P¬C and mean push-up performance is higher for P¬C than C¬P. Three of the four differences are statistically significant. The sole difference that is not significant is itself instructive: P¬C is not significantly different from C¬P for spring curl-ups in Panel *a*. As noted earlier, P¬C is not significantly different from *Full* focal for push-ups but both are better than C¬P and *Not* AT. Both mile assessments show higher mean performance by P¬C than C¬P although the differences are not significant. Finally, the sole AT cell that is not significantly worse at mile run than *Full* focal is P¬C in Panel *c*.

Focal performance across the 10-cell systematic focal partition, AA∩AT

Figure 2 examines performance across the AA∩AT partition for six events (3 Activities × 2 Times). Cell mean with 95% CI on mean are shown via whisker plots. At the bottom of each plot are *p* values for each of the 45 difference between means tests for each event (ordered by *Row* and *Column*). The four 2 systematically focal outcomes *Columns* and the *Full* outcome *Column* are shown against a gray background to distinguish them from the *Not Column* and the four 3 focal outcomes *Columns*, one AT the other AA. The 3 focal outcomes cells are listed as 2Activity2Time (eg. 2P2F rather than 3F&P) to emphasize the AT and AA aspect of the cell.

**** Figure 2 about here ****

Analysis of relative mean performance across the 10 possible focal outcomes requires 45 pairwise comparisons for each of the six events. The difference between means test *p* values in Figure 2 suggest that more than half of the differences are significant (143 of 270). These significant differences are not uniformly distributed across activities. Two-thirds of the push-up differences are significant (60 of 90), 56% of curl-up differences are significant (50 of 90), and 37% of mile differences are significant (33 of 90). There are also systematic differences across groupings (*Not*, 2 systematically focal, 3 focal, and *Full*) within the 10-cell partition. *Not* is significantly different from the other nine cells 87% of the time (47 of 54 *Not Columns p* values) and *Full* is significantly different from the four 2 systematically focal cells 75% of the time (18 of 24 below each "box" in Figure 2). All other cross-group comparisons have below 50% significant differences (44% for within 2 systematically focal [16 of 36 above each "box"], 42% for 2 versus 3 [40 of 96 in each "box"] and for 3 versus *Full* [10 of 24 right-most four *p* values in each *Full Row*], and 33% for within 3 focal [12 of 36 to the right of each "box"]).

A conservative approach for analyzing performance differences is to focus attention on those partition cell pairs where significant differences exist. This is accomplished in Figure 3

which shows significant mean difference with whiskers showing 95% CI on mean difference in three panels, one for each activity. The top half of each panel is dedicated to fall mean differences and the bottom half is dedicated to spring mean differences. The 45 comparisons for each event (Activity × Time) are organized using the *p* value *Row* and *Column* ordering from Figure 2. Consider the fall curl-up comparison of 2P *Row* and *Not Column* in the upper left corner of Panel *a.* This is associated with the first *p* value *Row* in Figure 2, Panel *a*. The fall curl-up performance data in Figure 2, Panel *a* show that 2P students, on average, do 4 more curl-ups than *Not* students, CI [3, 5]. This is seen by the mean difference of $M = 4$, CI [3, 5] in the *Not Column* of the 2P *Row*, the left-most entry in Figure 3, Panel *a*. Differences that are not significant at the 5% level are set to zero to focus attention on significant differences (for example, the third entry for fall curl-ups in Figure 3, Panel *a*, 2C *Row*, 2P *Column*, depicts no significant difference between 2C and 2P because $p = .468$ in Figure 2, Panel *a*). Superior performance by *Column* relative to *Row* is seen as mean difference CIs in the positive range for push-ups and curl-ups and in the negative range for mile run.

**** Figure 3 about here ****

In general, students with 2 systematically focal outcomes have superior performance to students with no systematic focal outcomes but inferior performance to those with 3 or 4 focal outcomes. This general impression, however, masks some systematic differences across the four groupings (*Not*, 2 systematically focal, 3 focal, and *Full*).

Students in the *Not* systematically focal cell have significantly worse curl-up performance to all systematically focal subsamples except 2F for curl-ups in the spring. The lowest push-up performance both times is 2C; in both instances, this performance is significantly worse than *Not* students at the 5% level. *Not* students are significantly worse at push-ups than all

other subsamples except focal curl-up students who are also focal in the other period (2C2S in the fall and 2C2F in the spring). Mile performance by *Not* students is significantly worse than all other cells except 2S in the fall and 2C in both periods.

The 2C cell appears weaker than the other forms of 2 systematically focal outcomes. Superior performance shown by 2F students in their fall performances appears to pull up their spring performances in the mile and push-ups but not for curl-ups where 2S students have significantly higher performance than 2F students. The strongest of the four 2 systematically focal outcomes is 2P which has overall performance rankings more in line with the 3 focal outcomes cells than the other 2 systematically focal outcomes cells.

Each of the four 3 focal outcomes cells exhibit the same pattern: the lowest average performance on an event is obtained by students who are not focal on that event. Three of these events have difference between means tests which show that this performance is significantly below two of the other three cells. Consider, for example, curl-ups in the fall. On this event, the lowest of the 3 focal average performances is by 2P2S (¬cf) and this performance is significantly below that posted by 2C2F and 2C2S students. Similar statements can be made of 2P2F for spring curl-ups and 2C2S for fall push-ups. For spring push-ups, 2C2F is significantly worse than only one of the other three cells, 2P2S. On both mile performances, there are no significant differences between the four 3 focal outcomes cells. Finally, although *Full* shows the fastest average mile time for both assessments, it is, in general, not significantly faster than the 3 focal outcomes cells. The only time *Full* is significantly better at the mile than a 3 focal outcomes cell is 2P2F for the fall mile event ($p = .042$).

A simple way to summarize the relative performance of each cell and to compare these performances across events is to rank order the performances from 1 (*best*) to 10 (*worst*). Figure

4 provides rank orderings of the six individual performances in Panel *a*, and aggregations across time for a given activity and across activities for a given time in Panel *b*. Cell pairs with $p > .9$ in Figure 2 have mean performances that are virtually identical to one another. These were provided the same midpoint ranking (so that the ranking of 2C and 2P2S for fall curl-ups both have rank 7.5 because $p_{2C,2P2S} = .931$ and that the ranking for 2P, 2C, and 2P2F for spring curl-ups is 7 because of *p* values of .935, .903, and .970 between these cells).

**** Figure 4 about here ****

The rank ordering of performance on individual events across the 10-cell focal partition in Panel *a*. shows the greatest variation in rankings among the 3 focal outcomes cells, due in large part to inferior performance on the non-focal event. The weakest of the 3 focal outcomes cells is seen to be 2P2F. Among the 2 systematically focal outcomes cells, 2C has the worst overall performance with spring curl-ups performance being the best at 7th. The two across activities outcomes have roughly similar rankings with 2F having superior performance on fall activities and 2S having superior performance on spring activities. And, as noted above, 2P has a performance profile that is more like the 3 focal outcomes cells than the other 2 systematically focal outcomes cells. At the extremes, 2C and *Not* appear to have equally inferior performance and *Full* has the best.

A similar pattern emerges upon averaging across activities and across time in Panel *b* of Figure 4. The best performance among the 2 systematically focal outcomes is the activity or time that defines the focal outcome. The difference in rank between this best and the second best is more than a full point for the two across time outcomes (Fall and Spring for 2F and 2S) but minimally less for the two across activity outcomes (Curl-ups and Push-ups for 2C and 2P). For each of these, Push-ups is only slightly worse than Fall or Spring in 2F and 2S. Among the 3

focal outcomes cells, the activity that is not focal has the worst ranking three of four times. Only for 2P2F is Curl-ups slightly more highly ranked than Spring or Mile run, but the difference between the three is less than a half point. *Full* is top ranking for five of the six averaged orderings with 2P2S being the only cell to dominate *Full* for Push-ups.

DISCUSSION

The general focal proclivity and focal performance findings Erfle and Gelbaugh (2013) analyzed across two activities (AA) at one assessment time are confirmed and extended by utilizing a second assessment time in a rather intuitive fashion. In regard to proclivity across time (AT), focal scores occurred more frequently than random processes would dictate. There is a clear indication that students tend toward these focal scores with increasing intentionality. At opposing ends of the spectrum, there were 3129 students with no focal events (*None* in Table 1), 35% below the 4844 that would be expected based on random processes but 86 students with four focal events (*Full* in all tables and figures), 23 times the 3.7 that would be expected based on random processes (4844 =.8 × .9 × .8 × .9 × 9345 and 3.7 =.2 × .1 × .2 × .1 × 9345).

Focal proclivity was greater in the spring than in the fall. Of course, students were older during the spring assessment and likely experienced improvements in ability. They were also more familiar with fitness testing having already participated in the fall fitness assessment. These are all attributes which should lead students to be more focal AA, according to Erfle and Gelbaugh (2013). For each of the three systematic focal partitions examined in Table 2, the only cell with actual membership below expected membership is the one with no systematic focal behavior. *Full* is the most important contributor to chi-square for each partition. Students do not arrive at focal outcomes in a random manner; they gravitate toward them in a systematic fashion. If a student is focal across activities for a single time period, it is less likely that the student will

be non-focal on both events in the other time period. Similarly if a student is focal on one activity across time, it is less likely that the student will be non-focal on the other activity at both times.

Adopting a systematic focal strategy in fitness testing leads to systematic differences in physical fitness performance. In general, performance differences among focal groups are more pronounced for push-ups and curl-ups than for mile run, a result that is not surprising when one recalls that focal behavior is defined in terms of push-ups and curl-ups. In every case, performance differences are most pronounced in the activities for which the student is focal. The present research has shown that the performance profiles of those who are focal on push-ups AT are superior to those who are focal on curl-ups AT. This is likely a testament to the relative difficulty of push-ups compared to curl-ups.

Performance on the AA∩AT cross-classification perspective illustrates that the number of focal outcomes achieved is a positive predictor of physical fitness performance. Those with 2 systematically focal outcomes perform better, in general, than those who are not systematically focal but worse than those who have 3 focal outcomes, and those with four focal outcomes (*Full* focal) have the best physical fitness performance profile. When students demonstrated systematic focal behavior, we observed higher fitness test scores relative to those with less pronounced focal behavior. This study is therefore consistent with the finding that "it is imperative for students to adopt a *multiple goal perspective* if exercise energy and persistence are to be optimized" (Gao et al., 2012, p. 256). The multiple goals need not be multiple activities at one point in time, but instead may be the same activity, such as push-ups, across time.

The present study suffers from the same limitations as Erfle and Gelbaugh (2013). The data was gathered as part of an analysis of middle-school obesity, not the intrinsic motivation of

students towards physical activity performance. Understanding what motivates focal students is critical to being able to effectively transfer their motivation to non-focal students. Because motivation is an unobservable phenomenon, indirect measures act as a proxy for motivation. Some studies on the subject have relied on questionnaires to infer the nature of motivation while others have used behavioral metrics such as the free-choice measure (Mayer, Faber, & Xu, 2007). Perhaps focal persistence across time as well as activities is a behavioral metric of effortful persistence. To determine whether focal persistence is a behavioral metric for effortful persistence it would be worthwhile to have students complete questionnaires examining this topic (Liew et al., 2011). Persistence and effort are important antecedents of motivation in both the classroom and physical education (Gao & Newton, 2009).

Given the literature on the role of teacher support in fostering motivational constructs it seems worthwhile to examine how coaches and physical educators should approach the task of motivating students to strive for the next focal outcome (Zhang, Solmon, & Gu, 2012). Teaching toward focal outcomes, encouraging students to count by fives and tens, may satisfy the goal of increasing the students' self-efficacy in physical education. This strategy "should help students maintain relatively accurate but high self-efficacy by achieving actual success on tasks; keeping tasks relatively challenging but at a reasonable level of difficulty; providing accurate and timely feedback; and using role models to provide vicarious experiences" (Gao et al., 2011, p. 32).

It is an open question whether external influences such as coaching toward focal outcomes would produce results similar to those obtained via the internal mechanism of counting by fives and tens used by focal striving middle school students. To answer this question, it would be informative to perform a controlled experiment where an instructor in the treatment group

encouraged students to strive for the next round number and the instructor in the control group encouraged students to do their best.

Another useful extension of the present analysis would be to examine whether the results are substantially different if focal curl-ups had been defined using multiples of 5 rather than 10. Curl-up peaks do exist with last digit 5 but the peaks are not as substantial as those with last digit 10, and the original rationale of using 10 for curl-ups and 5 for push-ups remains. That rationale maintained that choosing 5 for push-ups and 10 for curl-ups allows the average student to have approximately the same number of chances of stopping at a focal outcome for both activities.

To Schelling, a focal point is a point achieved in a negotiation due to its prominence or lack of ambiguity (Schelling, 1960). In bargaining over numerical magnitudes, this lack of ambiguity is typically achieved at round number outcomes (50% share for both players in a two party game or a house sales price of $200,000 rather than $201,234). Focal points are not unique to game-theoretic situations but are more generally the result of the degree of comfort that an individual feels toward counting with round numbers such as 5 and 10. From our earliest childhood, we have counted by 5 and 10 using our fingers. This paper has presented evidence that such focal counting is not the result of random processes and that those who systematically engage in focal counting achieve superior performance to those who do not count this way.

References

Andres, M., Di Luca, S., & Pesenti, M. (2008). Finger counting: The missing tool? *Behavioral & Brain Sciences, 31*(6), 642-643. doi:10.1017/S0140525X08005578

Baroody, A. J. (1985). Mastery of basic number combinations: Internalization of relationships or facts? *Journal for Research in Mathematics Education, 16*, 83-105. doi:10.2307/748366

Campbell, J. I. D., & Graham, D. J. (1985). Mental multiplication skill: Structure, process, and acquisition. *Canadian Journal of Psychology, 39*, 338-366. doi:10.1037/h0080065

Erfle, S. E., & Gelbaugh, C. M. (2013). Physical activity performance of focal middle school students. *Measurement in Physical Education & Exercise Science, 17*(2), 150-166. doi:10.1080/1091367X.2013.761034

Gao, Z., & Newton, M. (2009). Examining the mediating role of strategy use on students' motivation and Persistence/Effort in physical education. *Journal of Sport Behavior, 32*(3), 278.

Gao, Z., Lee, A. M., Xiang, P., & Kosma, M. (2011). Effect of learning activity on students' motivation, physical activity levels and Effort/Persistence. *ICHPER -- SD Journal of Research in Health, Physical Education, Recreation, Sport & Dance, 6*(1), 27-33.

Gao, Z., Podlog, L. W., & Harrison, L. (2012). College students' goal orientations, situational motivation and Effort/Persistence in physical activity classes. *Journal of Teaching in Physical Education, 31*(3), 246-260.

Liew, J., Xiang, P., Johnson, A. Y., & Oi-Man Kwok. (2011). Effortful persistence and body mass as predictors of running achievement in children and youth: A longitudinal study. *Journal of Physical Activity & Health, 8*(2), 234-243.

Martinek, T. J., & Williams, L. (1997). Goal orientation and task persistence in learned helpless and mastery oriented students in middle school physical education classes. *International Sports Journal, 1*(1), 63-76.

Marton, F. (1992). Phenomenography and "the art of teaching all things to all men''. *International Journal of Qualitative Studies in Education (QSE), 5*(3), 253.

Mayer, J. D., Faber, M. A., & Xu, X. (2007). Seventy-five years of motivation measures (1930-2005): A descriptive analysis. *Motivation and Emotion, 31*(2), 83-103. doi:10.1007/s11031-007-9060-2

Mulligan, J. T., & Mitchelmore, M. C. (1997). Young children's intuitive models of multiplication and division. *Journal for Research in Mathematics Education, 28,* 309-330. doi:10.2307/749783

Schelling, T. C. (1960). *The strategy of conflict*. Cambridge, Massachusetts: Harvard University Press.

Zhang, T., Solmon, M. A., & Gu, X. (2012). The role of teachers' support in predicting students' motivation and achievement outcomes in physical education. *Journal of Teaching in Physical Education, 31*(4), 329-343.

TABLE 1. *Four Views of the Sixteen Possible Focal Outcomes based on Two Activities Assessed Two Times*

a) Assuming random last digit for each activity × time

		Focal in the spring			
		¬ps¬cs	ps¬cs	cs¬ps	pscs
		f_e=.8×.9	f_e=.2×.9	f_e=.1×.8	f_e=.2×.1
Focal in the fall	¬pf¬cf	*None*	ps	cs	2S
	f_e=.8×.9	3129; -24.6	1311; 2.7	600; 2.9	307; 14.9
	pf¬cf	pf	2P	pfcs	2P2S
	f_e=.2×.9	1135; 1.7	682; 14.5	234; 14	192; 24.8
	cf¬pf	cf	cfps	2C	2C2S
	f_e=.1×.8	577; -2.2	297; 8.6	172; 21.8	111; 27.3
	pfcf	2F	2P2F	2C2F	*Full*
	f_e=.2×.1	277; 12.3	145; 19.4	90; 19.2	86; 42.5

χ^2 = 5875, *df* = 15, *p* < .001.

b) Assuming independence across assessment times: comparing spring proportions for a given fall outcome

		Focal in the spring			
		¬ps¬cs	ps¬cs	cs¬ps	pscs
Focal in the fall	¬pf¬cf	*None*	ps	cs	2S
		3129_a; 3.7	1311_b; -2.2	600_b; -1.1	307_c; -4.6
	pf¬cf	pf	2P	pfcs	2P2S
		1135_a; -2.7	682_b; 4	234_a; -1.8	192_b; 1.9
	cf¬pf	cf	cfps	2C	2C2S
		577_a; -2.3	$297_{a,b}$; -0.3	172_c; 3.1	$111_{b,c}$; 2.7
	pfcf	2F	2P2F	2C2F	*Full*
		277_a; -2.8	$145_{a,b}$; -0.9	90_b; 2.4	86_c; 6.2

χ^2 = 145.8, *df* = 9, *p* < .001.

c) Assuming independence across activities: comparing curl-ups proportions for a given push-ups outcome

		Focal on curl-ups			
		¬cf¬cs	cf¬cs	cs¬cf	cfcs
Focal on push-ups	¬pf¬ps	*None*	cf	cs	2C
		3129_a; 2.4	$577_{b,c}$; -1.8	600_c; -1.5	172_b; -3.2
	pf¬ps	pf	2F	pfcs	2C2F
		1135_a; -0.8	277_b; 2.3	$234_{a,b}$; -0.9	$90_{a,b}$; 0.5
	ps¬pf	ps	cfps	2S	2C2S
		1311_a; -1.2	297_a; 1	307_a; 1.1	111_a; 1.2
	pfps	2P	2P2F	2P2S	*Full*
		682_a; -2.1	$145_{a,b}$; -0.7	$192_{b,c}$; 2.7	86_c; 4.3

d) Assuming independence across activities: comparing push-ups proportions for a given curl-ups outcome

		Focal on push-ups			
		¬pf¬ps	pf¬ps	ps¬pf	pfps
Focal on curl-ups	¬cf¬cs	*None*	pf	ps	2P
		3129_a; 2.4	1135_b; -0.8	1311_b; -1.2	682_b; -2.1
	cf¬cs	cf	2F	cfps	2P2F
		577_a; -1.8	277_b; 2.3	$297_{a,b}$; 1	$145_{a,b}$; -0.7
	cs¬cf	cs	pfcs	2S	2P2S
		600_a; -1.5	234_a; -0.9	$307_{a,b}$; 1.1	192_b; 2.7
	cfcs	2C	2C2F	2C2S	*Full*
		172_a; -3.2	$90_{a,b}$; 0.5	$111_{b,c}$; 1.2	86_c; 4.3

For Panels *c* and *d* , χ^2 = 65.6, *df* = 9, *p* < .001.

Note. Cell acronyms use lower case letters for individual behavior and upper case letters for systematic behavior (read ¬ as not). Intermediate levels of systematic focal behavior on push-ups across time (P), curl-ups across time (C), or across activities in the fall (F) or spring (S) describe how many focal events are included (out of four) so 2P2F represents focal on both push-up performances and both activities in the fall. Expected outcomes and standardized residuals are based on random endings in Panel *a,* and in Panels *b – d* are based on column and row independence.

TABLE 2

Three Systematic Focal Partitions: Across Activities, Across Time, and Across Activities and Time

		Focal across time (AT)				
		Not AT	P¬C	C¬P	*Full*	Total AA
Focal across activities (AA)	*Not* AA	*Not* 7283; .040	2P (¬2C) 682; .092	2C (¬2P) 172; .041	-	*Not* AA 8137; .023
	F¬S	2F (¬2S) 277; .029	2P2F (¬cs) 145; .071	2C2F (¬ps) 90; .073	-	F¬S 512; .170
	S¬F	2S (¬2F) 307; .043	2P2S (¬cf) 192; .144	2C2S (¬pf) 111; .119	-	S¬F 610; .286
	Full	-	-	-	*Full* 86; .349	*Full* 86; .521
	Total AT	*Not* AT 7867; .029	P¬C 1019; .287	C¬P 373; .226	*Full* 86; .457	

Note. Each cell in each partition contains three elements; a cell name, actual cell count, and contribution to chi-square after the semicolon. $\chi^2 = 3474$, $df = 3$, $p < .001$ for AA; $\chi^2 = 3958$, $df = 3$, $p < .001$ for AT; and $\chi^2 = 5180$, $df = 9$, $p < .001$ for AA∩AT. Expected values for each partition are based on independent last digit ending as described in Table 1, Panel *a* . Contributions based on negative standardized residuals are underscored. *Not* in AA∩AT is composed of seven cells in Table 1, *None* , pf, cf, ps, cs, pfcs, and cfps. Cells with intermediate levels of systematic focal behavior on push-ups across time (P), curl-ups across time (C), or across activities in the fall (F) or spring (S) and acknowledge in parentheses the event(s) that was(were) not focal (read ¬ as not). Lower case letters describe individual events and upper case denotes paired events so 2P2F represents focal on both push-up performances and both activities in the fall but not curl-ups in the spring (¬cs).

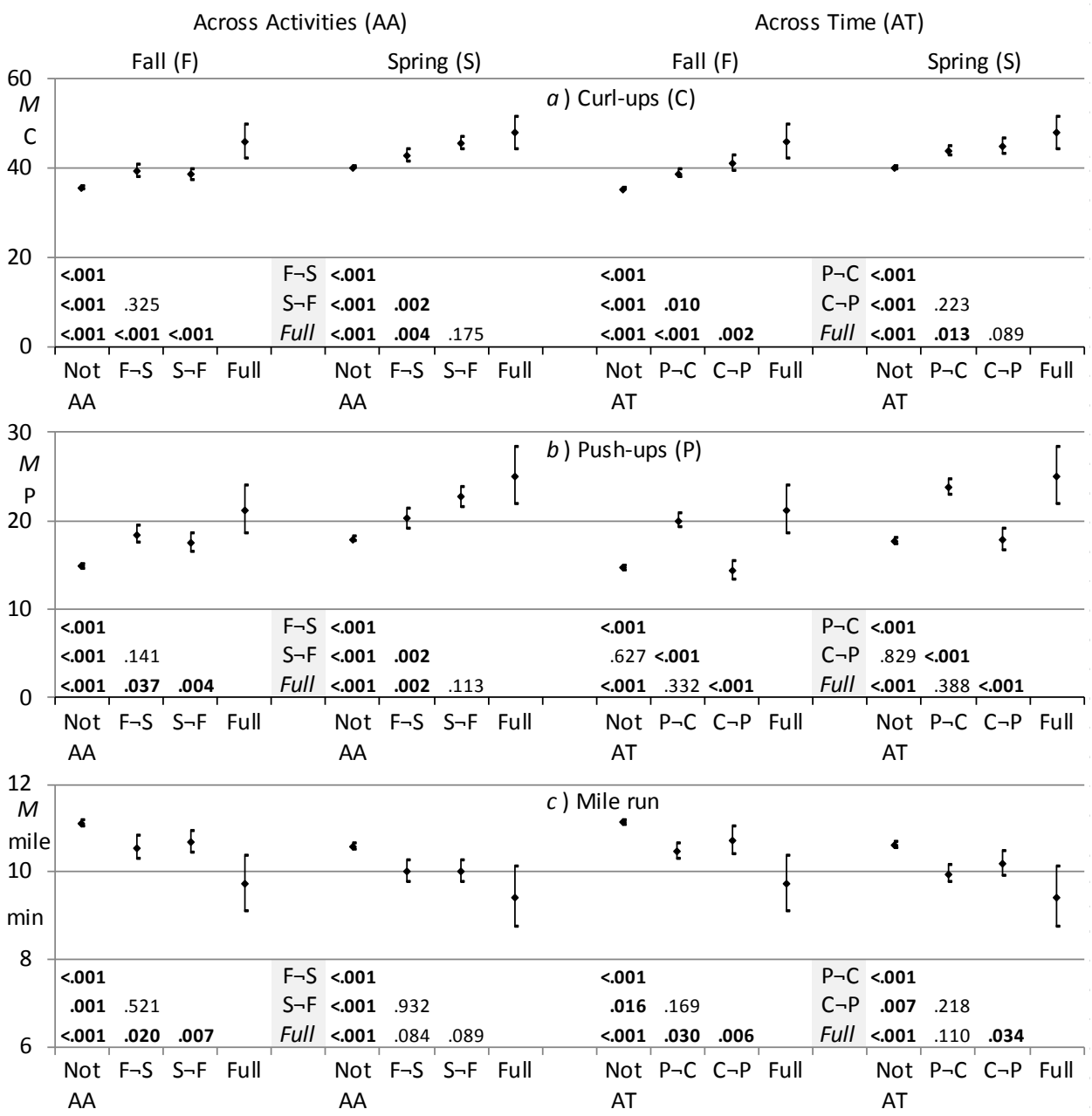
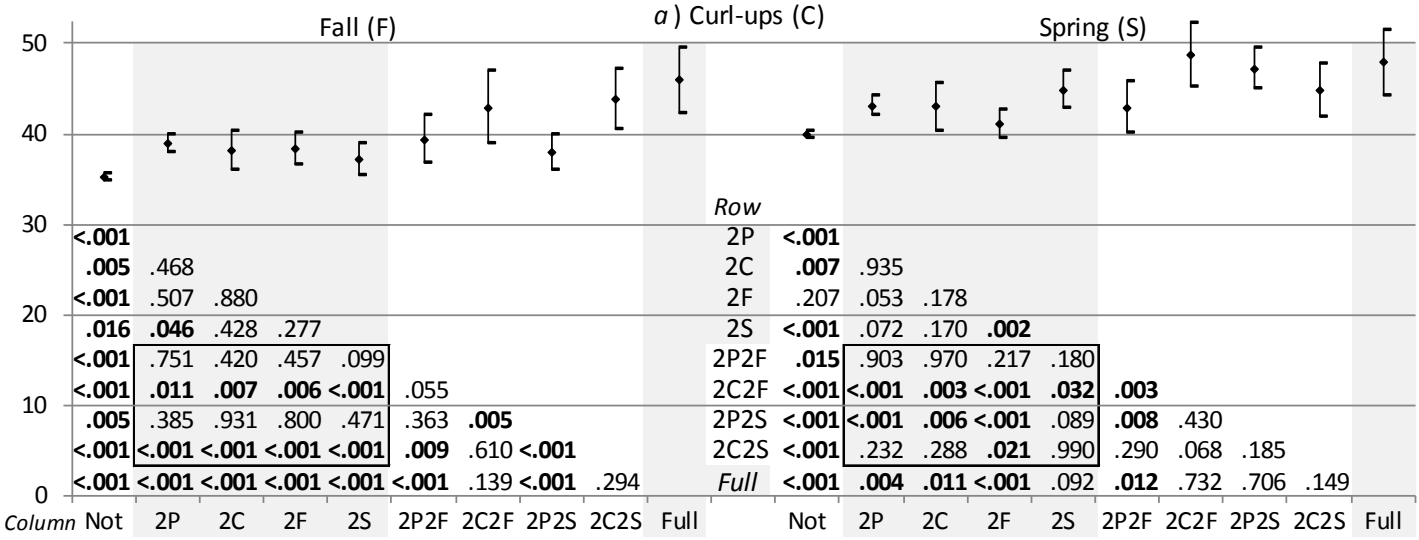
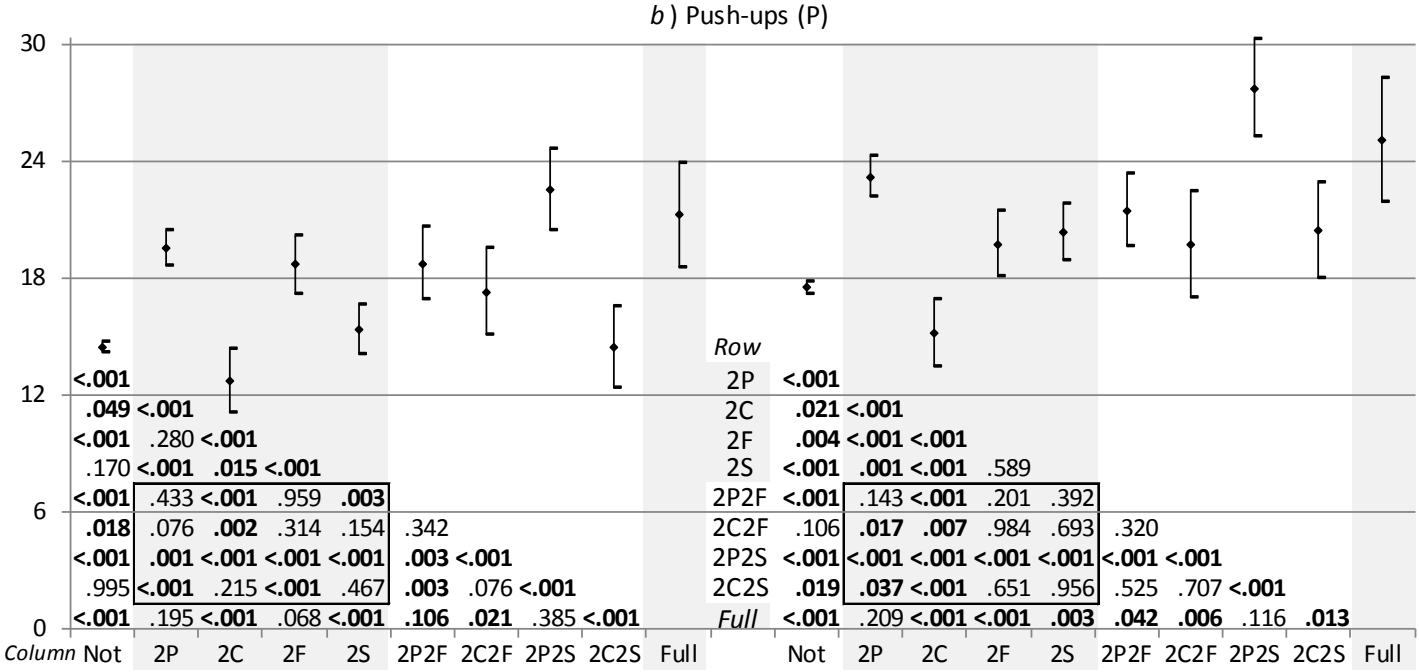


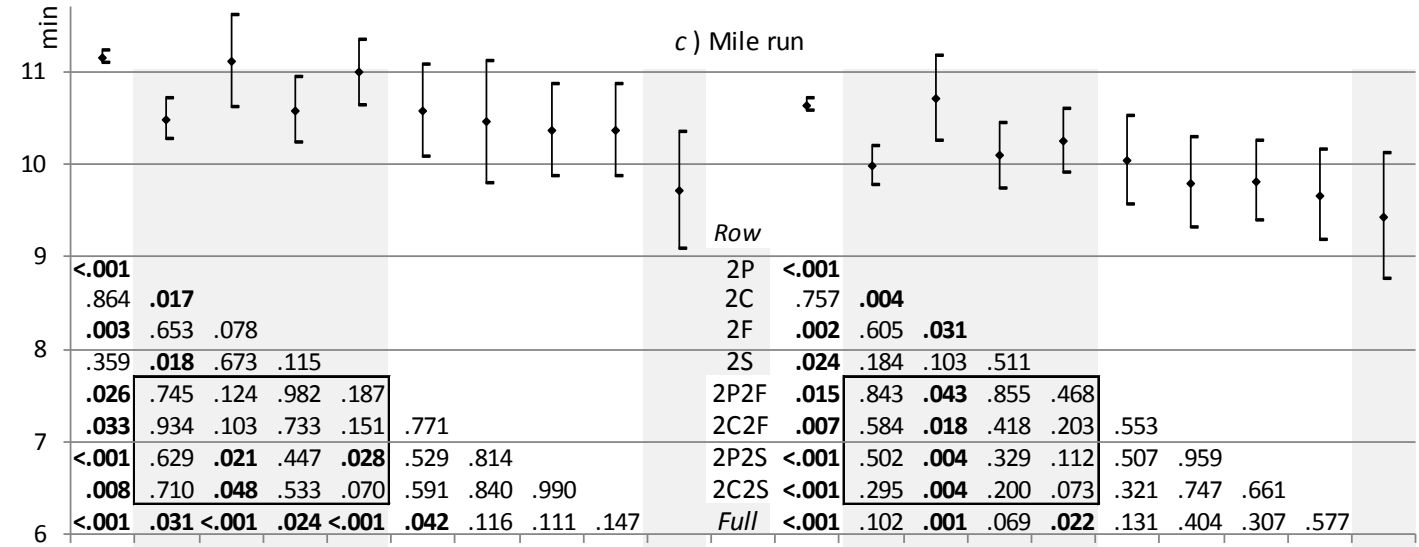
Figure 1. Mean performance (with whiskers showing 95% CI on mean) on three activities at two assessments by two systematic focal partitions. Cell membership sample sizes are shown in Table 2. An acronym key is provided in the legends and titles. Read ¬ as not so that P¬C means students were focal across time for push-ups but not curl-ups. Difference between means test *p* values are provided at the bottom of each panel with significant differences in boldface. For example, the (F¬S, S¬F) fall mile $p = .521$ signifies that the F¬S mean fall mile time is not significantly different from the S¬F mean fall mile time.



Column	Not	2P	2C	2F	2S	2P2F	2C2F	2P2S	2C2S	Full
Not		**<.001**	**.005**	**<.001**	**.016**	**<.001**	**<.001**	**.005**	**<.001**	**<.001**
2P	**<.001**		.468	.507	**.046**	.751	**.011**	.385	**<.001**	**<.001**
2C	**.007**	.935		.880	.428	.420	**.007**	.931	**<.001**	**<.001**
2F	.207	.053	.178		.277	.457	**.006**	.800	**<.001**	**<.001**
2S	**<.001**	.072	.170	**.002**		.099	**<.001**	.471	**<.001**	**<.001**
2P2F	**.015**	.903	.970	.217	.180		.055	.363	**.009**	**<.001**
2C2F	**<.001**	**<.001**	**.003**	**<.001**	**.032**	**.003**		**.005**	.610	**<.001**
2P2S	**<.001**	**<.001**	**.006**	**<.001**	.089	**.008**	.430		.139	**<.001**
2C2S	**<.001**	.232	.288	**.021**	.990	.290	.068	.185		.294
Full	**<.001**	**.004**	**.011**	**<.001**	.092	**.012**	.732	.706	.149	

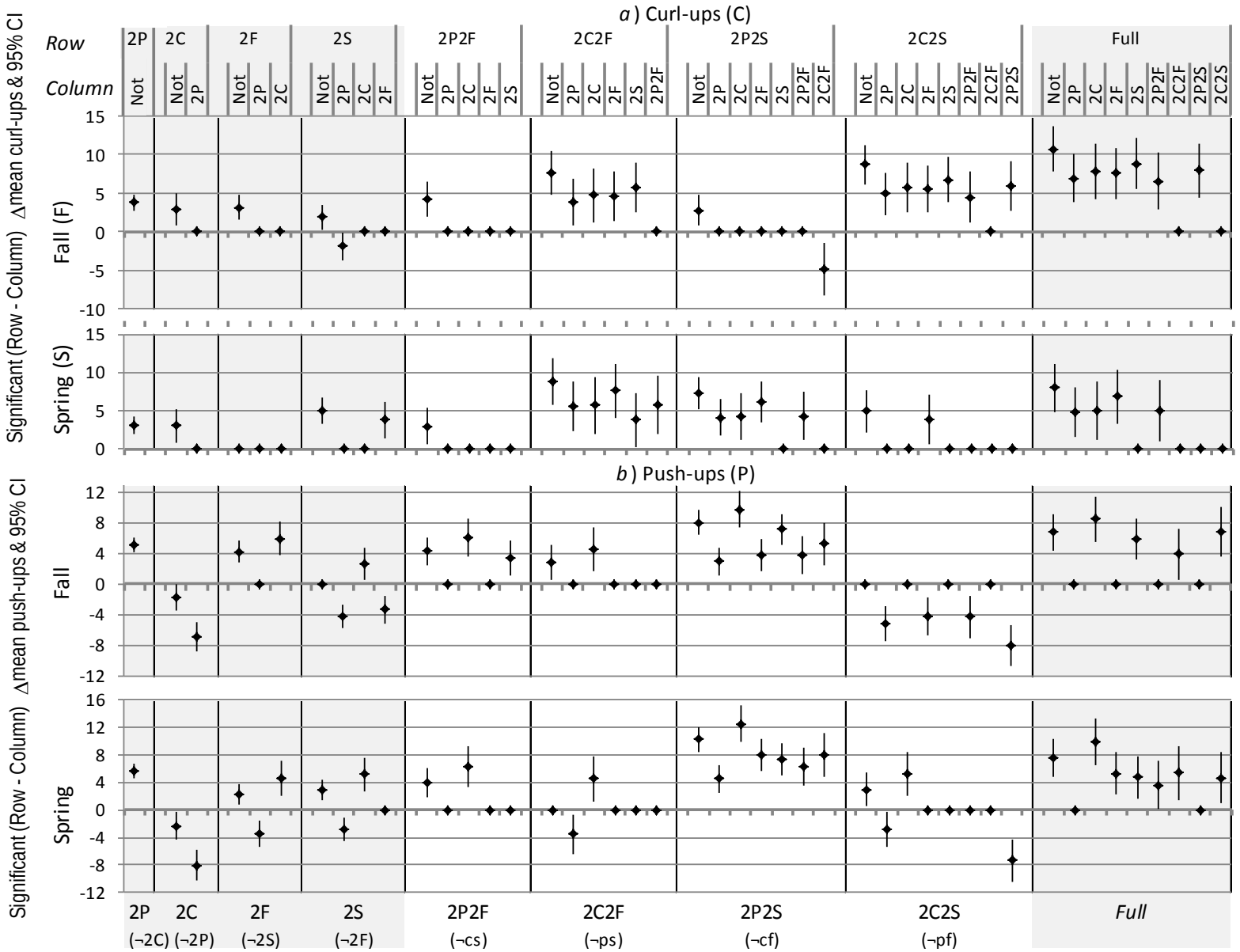


Column	Not	2P	2C	2F	2S	2P2F	2C2F	2P2S	2C2S	Full
Not		**<.001**	**.049**	**<.001**	.170	**<.001**	**.018**	**<.001**	.995	**<.001**
2P	**<.001**		**<.001**	.433	**<.001**	.076	**.001**	**<.001**	**<.001**	.195
2C	**.021**	**<.001**		.280	**<.001**	.433	**.002**	**<.001**	.215	**<.001**
2F	**.004**	**<.001**	**<.001**		**.015**	.959	.314	**<.001**	**<.001**	.068
2S	**<.001**	**.001**	**<.001**	.589		**.003**	.154	**<.001**	.467	**<.001**
2P2F	**<.001**	.143	**<.001**	.201	.392		.342	**.003**	**.003**	**.106**
2C2F	.106	**.017**	**.007**	.984	.693	.320		**<.001**	.076	**.021**
2P2S	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**	**<.001**		**<.001**	.385
2C2S	**.019**	**.037**	**<.001**	.651	.956	.525	.707	**<.001**		**<.001**
Full	**<.001**	.209	**<.001**	**<.001**	**.003**	**.042**	**.006**	.116	**.013**	

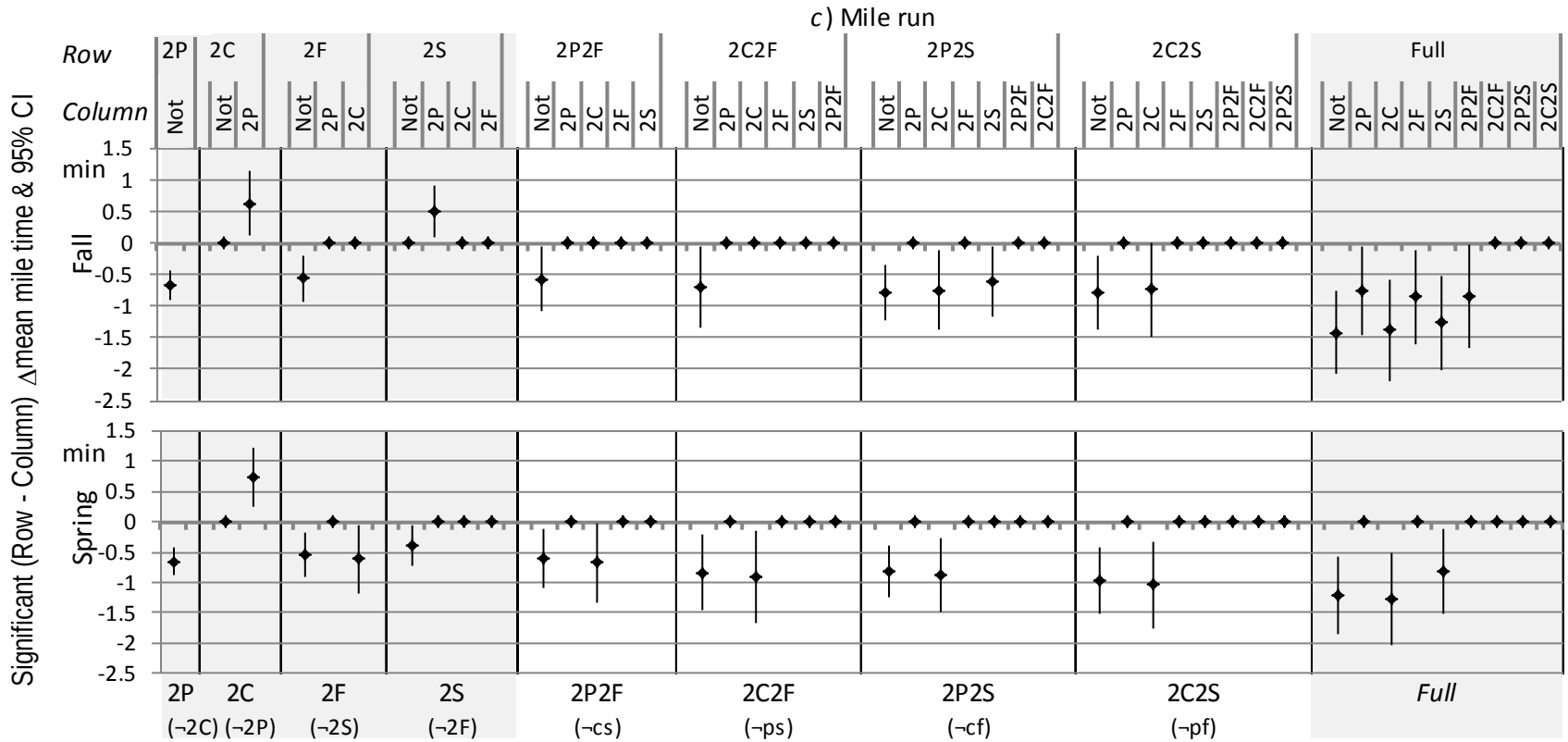


Column	Not	2P (¬2C)	2C (¬2P)	2F (¬2S)	2S (¬2F)	2P2F (¬cs)	2C2F (¬ps)	2P2S (¬cf)	2C2S (¬pf)	Full
Not		**<.001**	.864	**.003**	.359	**.026**	**.033**	**<.001**	**.008**	**<.001**
2P	**<.001**		**.017**	.653	**.018**	.745	.934	.629	.710	**.031**
2C	.757	**.004**		.078	.673	.124	.103	**.021**	**.048**	**<.001**
2F	**.002**	.605	**.031**		.115	.982	.733	.447	.533	**.024**
2S	**.024**	.184	.103	.511		.187	.151	**.028**	.070	**<.001**
2P2F	**.015**	.843	**.043**	.855	.468		.771	.529	.591	**.042**
2C2F	**.007**	.584	**.018**	.418	.203	.553		.814	.840	.116
2P2S	**<.001**	.502	**.004**	.329	.112	.507	.959		.990	.111
2C2S	**<.001**	.295	**.004**	.200	.073	.321	.747	.661		.147
Full	**<.001**	.102	**.001**	.069	**.022**	.131	.404	.307	.577	

Figure 2. Mean performance (with whiskers showing 95% CI on mean) on 3 Activities × 2 Assessments for the 10-cell focal partition AA∩AT. Partition membership sample sizes are shown in Table 2. An acronym key is provided in the legends and titles (read ¬ as not). The four partially focal alternatives with 2 systematically focal outcomes and the *Full* focal outcome are shown against a gray background. Lower case letters signify individual events and upper case letters signify systematic focal pairs so 2P2F represents focal on both push-up performances and both activities in the fall but not curl-ups in the spring (¬cs). Difference between means test *p* values are provided at the bottom of each panel with significant differences in boldface. These *p* values are organized by *Row* and *Column* and are of central importance to examining significant differences in Figure 3.



Note: A negative CI implies *Column* is signficantly better than *Row* & a positive CI implies *Row* is significantly better than *Column* for curl-ups & push-ups.



Note: A positive CI implies *Column* is signficantly better than *Row* & a negative CI implies *Row* is significantly better than *Column* for mile run.

Figure 3. Significant mean performance difference with whiskers showing 95% CI on mean difference for 3 Activities × 2 Times using the 10-cell focal behavior partition $\mathrm{AA} \cap \mathrm{AT}$ from Table 2 and relative performance data from Figure 2. Each of the 45 pairwise comparisons in Figure 2 is shown in Figure 3 using Figure 2's *Row* and *Column* organization of *p* values (there is one pairwise comparison in *Row* 2P, two in *Row* 2C, . . ., and nine in *Row Full*). Boldfaced differences in Figure 2 (with $p < .05$) are shown with 95% CI on mean difference and differences with $p > .05$ in Figure 2 are set to zero. The four 2 systematically focal outcomes *Rows* and the *Full* focal outcome *Row* are shown against a gray background.

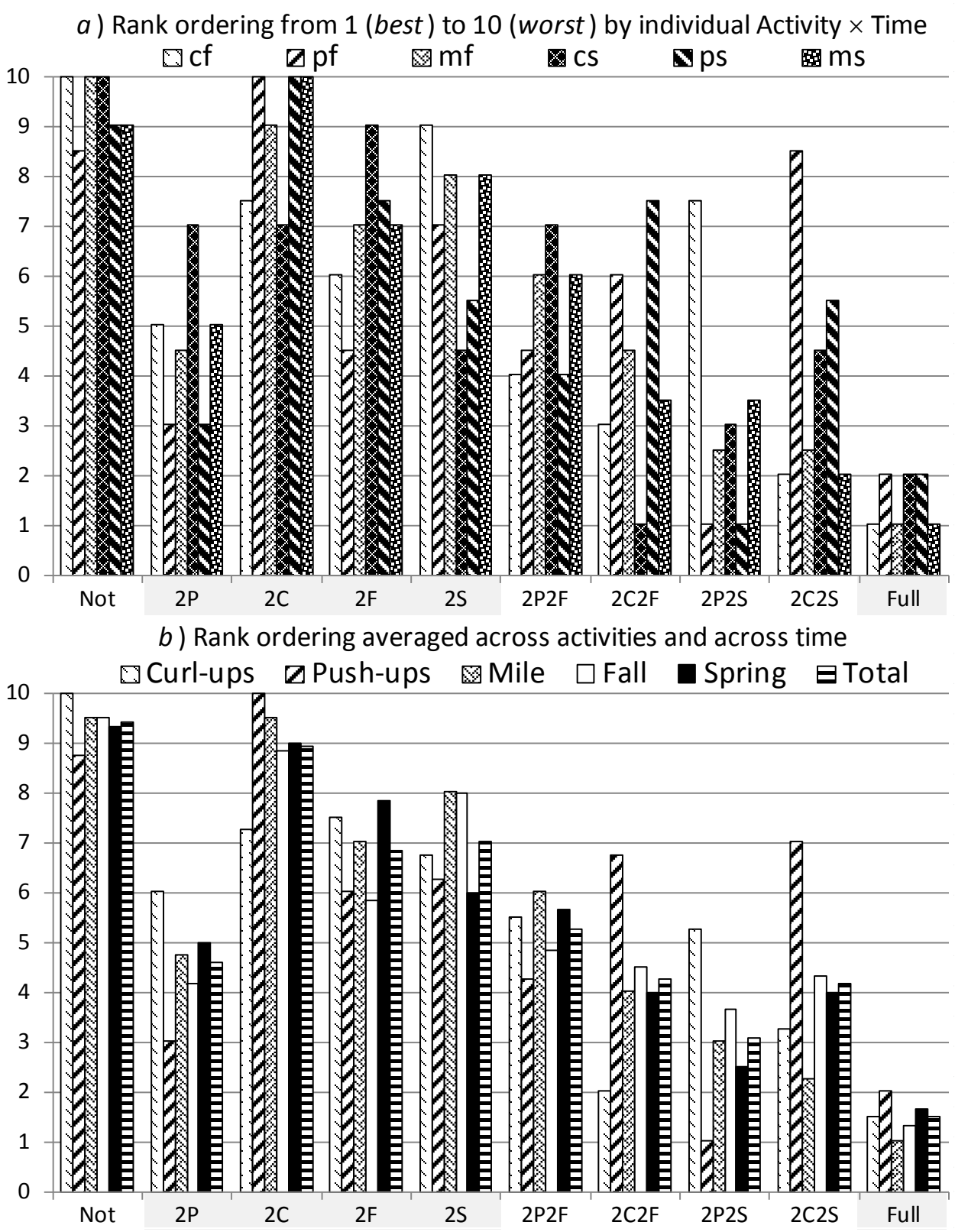


Figure 4. Rank ordering of mean performance across the 10-cell focal partition by individual event (top panel) and averaged across activities and time (bottom panel). Mean performance rankings from Figure 2 based on the 10-cell partition $\mathrm{AA} \cap \mathrm{AT}$ defined in Table 2. Performance pairs with $p > .9$ in Figure 2 were provided the same ranking for that event so that the ranking of 2C and 2P2S for fall curl-ups both have rank 7.5 because $p_{2C,2P2S} = .931$.