The Effects of the Physical Best Health-Related Fitness Curriculum on Physical Activity Levels of Primary-Aged Physical Education Students

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Abstract

This study analyzed the effect of Physical Best (PB) Curriculum on activity levels of children in physical education class. Activity levels of elementary school students (N=92, males = 50, females = 42) were recorded throughout six normally scheduled physical education class periods. Students participated in both traditional and PB curriculums and were asked not to change any physical activity and performance behaviors during data collection. Activity levels were recorded with movement tracking bracelets and heart rate monitors; which, provided averages for steps and time-in-target-zone (TZ) per class period. Paired sample t-tests were used to compare steps and TZ between the two groups. Overall, students did not record as many steps or time in target heart rate zone while participating in lessons that began with a PB warm-up. The differences of average steps and TZ recorded between PB and traditional curriculums were significant ($p< 0.05$) for all grades and gender, except third grade girls. The elementary school students in this study recorded, on average, fewer movements and spent less time in their target heart rate zone during PB activities than in their traditional activities. However, student knowledge of their own fitness outcomes may motivate them to be physically active outside of class.

Keywords: Physical education, fitness education, physical education curriculum, physical education technology

Introduction

Receiving formal education regarding healthy lifestyle choices early in life can promote an individual's likelihood of making those healthy choices later in life. The Physical Activity Guidelines Advisory Committee (2018) promotes physical activity through a list of guidelines designed to help reduce the risk of several different diseases and health conditions such as obesity, cardiovascular disease, dementia, and various cancers. These guidelines also suggest health benefits through physical fitness can be accrued by children, which will carry into adulthood (Telama et al., 2014). For children, the guidelines suggest 60 minutes of moderate-to-vigorous physical activity each day as well as regular engagement in similar activities. Research suggests that children who are physically inactive and obese are more likely to carry those traits into adulthood than children who display suggested characteristics of physical activity and body composition (Craigiea, Lakeb, Kelly, Adamsond, & Mathers, 2011).

In a Canadian physical activity longitudinal study with multiple measurements in a 22-year follow up, obesity at baseline measurement for youth (7-18 years) was a guaranteed indicator of obesity at the follow up measurement for men, and a high indicator of obesity for women (Herman, Craig, Gauvin, & Katzmarzyk, 2009). Of the children who were of healthy weight at baseline measurement, 50% of them maintained their healthy weight into adulthood. The evidence of youth physical fitness carryover into adult life is transparent; unfortunately, most of the youth in the United States (US) are not physically fit. In 2015, the Society of Health and Physical Educators (SHAPE America) provided percentages of pre-K-12 students who reached a certain target area for activity in America. The results indicated only 27.1% of those students who participated in 60 minutes of physical activity sessions daily increased breathing rate 7 days a week. This statistic indicates that less than 1/3 of youth in the US are meeting the suggested guidelines for physical activity. Overall, the lifestyle choices of youth in the US may predict the state of health in their future; which, at this time, youth in the US are not participating in high rates of physical activity (National Physical Activity Plan Alliance, 2018).

Physical education curriculums within the primary and secondary education systems of the US are set in place to promote daily physical activity and healthy lifestyle choices. SHAPE America provides standards for K-12 students serving as a definition of what children should know through their physical education experience (SHAPE America, 2013). According to the standards, children should display movement competencies, knowledge of movement concepts, skills to maintain health-enhancing levels of activity, responsible behavior within physical activity, and the value of physical activity for health and enjoyment (Barney & Deutsch, 2009). By interpreting the standards, it is clear that the emphasis of the physical education curriculum is not only on the rules and conduct within physical activities, but also it emphasizes the knowledge of health benefits that are an outcome of the physical activities.

The formatting of physical education curriculums is somewhat unique to the educator and has been studied extensively in research for its promotion of lifelong physical activity and health promotion (Kerner, Haerens, & Kirk, 2018; Petrie & Clarkin-Phillips, 2018; Bocarro, Kanters, Casper, & Forrester, 2008; Green, 2004). The Physical Best (PB) curriculum was established in 1987 by now

SHAPE America, with a mission of fostering a healthier youth by providing quality resources and professional education for educators (American Alliance for Health, Physical Education, Recreation and Dance [AAHPERD], 2011). The goals of PB are to: provide students with the education and skills to develop lifelong habits of physical activity, present why and how our body responds to physical activity, and emphasize individualization and enjoyment. In order to achieve these goals, physical educators must spend a portion of class time to teach the PB fitness concepts. The PB curriculum allows physical education (PE) teachers to implement health related fitness concepts (Aerobic Fitness, Muscular Strength, Muscular Endurance, Flexibility, and Body Composition) into their lesson plans without drastic changes to already existing curricula. Therefore, the PB program is not a standalone curriculum, but instead, supplementary material that is aligned with national standards for health and physical education and designed to promote PA and fitness throughout the lifespan (Deutsch & Christianson, 2014). This may be an unstudied downfall of the PB curriculum, where students' involvement requires more sedentary listening as opposed to participation in active motion for the majority of class time, as seen in some traditional styles of the physical education curricula and more specifically the traditional one used in this study. With more activity time in class, students may be more likely to achieve the guidelines' suggesting 60 minutes of moderate-to-vigorous activity each day. However, they will not receive the formal education on health-fitness concepts. Whereas, students involved with a PB curriculum might have to spend more physical activity time each day out of class to achieve the guideline; but, could be more motivated to do so given their new understanding of health-fitness concepts (Prichard & Deutsch, 2013). When a PE teacher chooses the PB curriculum, their student's time spent moving may be compromised. The lack of peer reviewed studies comparing activity levels accrued during PB and traditional curriculum necessitates further research. This study investigates the effect PB curriculum inclusion has on student's activity levels in elementary physical education class. Activity levels were recorded for students participating in PB and traditional curriculum activities in order to compare PB effect across age and gender. It is hypothesized that increased instructional time to promote health concepts education PB may decrease overall activity time of the students within PE class time.

Methods

Participants

Data were collected from 3rd (*N*=15), 4th (*N*=40), and 5th (*N*=37) grade students (ages 9-12 years) of an elementary school in the Midwest portion of USA (*N* = 92, males = 50, females = 42). Students participated in both traditional and PB curriculums and were asked to not change any physical activity and performance during data collection class periods, as a result of wearing the data collection devices. Informed consent was obtained from both parents and students, and all research procedures were approved by the University Institutional Review Board.

Instrumentation

Movement trackers or step counters have been identified as an economical tool to assess student movement (Pavlicek & Deutsch, 2016). Thus, A North Dakota SHAPE America grant provided 23 SODIAL Smart Wrist Band Sports Fitness Activity Tracker Pedometer Bracelet Watches to track the number of student movements during a class period. Movements can include not only steps but arm movements as well. These watches were used for data collection at the Elementary School and then retained by the school for daily physical education use afterward. The school also had received another grant to attain Adidas Zone Interactive Health Technologies (IHT) Spirit wrist heart rate monitors which measured the total number of minutes that students spent in their target heart rate zone during each lesson.

Procedure

For this study, the researchers chose three final activity games that each physical education class would participate in. Each class participated in the games during two different class periods, once with the inclusion of a new PB curriculum fitness concept warm-up activity, and once with the traditional curriculum warm-up activity, with the order of these two interventions randomized to limit learned effects (Table 1). For this study, PB activities were unfamiliar to students and contained lessons on various concepts of health fitness (Table 2). A traditional warm-up activity is one that each class was already familiar with and also did not contain an educational component of health-related fitness (Table 3). At the end of each session, students' movement numbers and time-in-target-zone (TZ) values for heart rate were recorded. TZ refers the amount of time students spent in Moderate Intensity (50-70% of Maximum Heart Rate) to High Intensity (70-85% of maximum Heart Rate) as determined by recording the student's age and monitoring students resting heart rate, to determine their Target Zone. These data provided for analysis of six different class sessions for each grade (3^{rd}-5^{th}). The sessions were grouped into two categories, traditional or PB warm-up, and the students participated in three sessions of each category over a four-week period. At the conclusion of each class session, their total number of movements and total number of minutes spent in the target heart rate zone were recorded, as the number was taken directly off of the watches and recorded on a spread sheet.

Table 1

Plan of Study

Day	PB Warm-up	Traditional Warm-up	Final Activity
1		Moana Tag	Treasure Hunter
2	Jumping Frenzy		Cardio Kickball
3		Quidditch	Ultimate Football
4	Artery Avenger		Treasure Hunter
5		Tic Tac Toe	Cardio Kickball
6	Clean the Beach		Ultimate Football

Table 2

Outline of PB Activities

PB Activity	Fitness Topic	Description
Jumping Frenzy	Exercise Intensity	Set up stations with instruction cards for various jump rope activities and stretches. Provide the "Am I giving my heart a workout?" chart at rest stations for children to self-assess what activities were most intense and beneficial to physical health.
Artery Avengers	Physical Activity	Using yarn balls (fat from food) and hula hoops (arteries), students try to fill opponent's hoops with yarn while keeping their hoops empty. Keeping hoops empty involves increased running and throwing, just as being more active keeps fat from the arteries to improve health.
Clean the Beach	Specificity	Students "clean the beach" by collecting bean bags (trash) and placing them in hula hoops (trash can) using various locomotor movements (walking on all fours, tip toes, hopping on one foot). After activity, outline the movements and their effect on muscular strength to different parts of the body to demonstrate knowledge of specificity.

Note: (AAPHERD, 2011).

Table 3

Outline of Traditional Activities

PB Activity	Fitness Topic	Description
Moana Tag	Exercise Intensity	Students move around the gym in a variety of movement patterns. The taggers tag students and once the students get tagged they go and "row their boats" (Russian Twists) to get back into the tag game after doing so 10 times.
Tic Tac Toe	Physical Activity	A small relay game, teams of 2-3 students. Students run down to a large tic tac toe board and place a bean bag into the board and run back, the next student runs down and places their bean bag and runs back. The third team member runs down and tries to make 3 in a row, if unsuccessful the game continues by players picking up a bean bag on the board and moving it to a new spot. As soon as the game is completed, it is quickly restarted from the beginning.
Quidditch	Specificity	Students throw a reaction ball across the gym. Once they throw the ball it must touch the opposite wall and then be collected and returned to the starting spot. The game involves high intensity activity and hand eye coordination, considering that a reaction ball comes off the wall differently every time due to its design.

Data Analysis

Data are represented using mean and standard deviation. Steps and TZ were averaged across all sessions for both PB and Traditional groups. Repeated measures ANOVAs were used to compare grade and gender differences. When a significant F statistic was found, additional analysis using paired sample t-tests were used to compare steps and TZ between the two groups for both grade and gender. Kolmogorov-Smirnov tests for normality were performed to ensure normally distributed data for steps [$D_{(92)} = 0.065$, $P > 0.05$] and TZ [$D_{(92)} = 0.053$, $P > 0.05$]. All statistical analyses were performed using SPSS version 24.0. Statistical significance was determined using $p < 0.05$.

Results

Overall, students did not record as many movements or time in target heart rate zone while participating in lessons that began with a PB warm-up (see Table 4). The lessons with traditional warm-up activities resulted in higher step counts [$F_{(2, 28)} = 3.711$, $P = 0.037$] and TZ [$F_{(2, 28)} = 6.555$, $P = 0.005$] for the male and female students in the three grades.

Upon separating the results by grade (see Tables 4), activity levels are still apparently higher with the use of a traditional warm-up activity, when compared to the activity levels using PB. Third grade girls (9-10 years) were least affected, showing the most similarity between activity levels using the PB and traditional warm-ups. *p*-values displayed in the tables indicate significant differences in activity levels for all groups, with the exception of third grade girls. Comparing the two warm-up methods, the calculated differences of their average steps/day were trending towards significant (p= 0.057) with 3rd grade girls, but the average time in zone values were not (p=0.241). Fifth grade boys (11-12 years) were most impacted by the PB curriculum, which means they showed the biggest gap in steps and time in heart rate zone with PB inclusion. The fifth grade boys (11-12 years) were more active than the third-grade girls (9-10 years) using the traditional warm-up [$t_{(14)} = 2.177$, $P = 0.047$]. This may indicate that the more active the group, the greater the effect of PB on activity levels. Overall, the activity levels seen with traditional warm-ups may differ between grade and gender; however, in this study, PB inclusion indicated lower activity levels for all grades and genders compared to the traditional warm-up activities.

Table 4

Average Steps and Time in Target Heart Rate Zone

	Average Steps/Day (Steps)				Average Time in Zone/Day (Minutes)			
All Grades	PB	Traditional	Difference	*P*-value	PB	Traditional	Difference	*P*-value
All, n=92	1528 ± 576.8	1942.2 ± 724.5	27.1%	0.000	18.5 ± 5.9	23.5 ± 5.5	27%	0.000
M , n=50	1555.3 ± 684.9	1941.1 ± 702.8	24.8%	0.000	18.5 ± 6.8	214.1 ± 5.6	29.9%	0.000
F, n=42	1500.8 ± 550.6	1897.1 ± 796.3	26.4%	0.000	18.5 ± 6.2	22.7 ± 5.8	22.4%	0.000
5th Grade	PB	Traditional	Difference	*P*-value	PB	Traditional	Difference	*P*-value
All, n=37	1437.3 ± 536.5	1922.1 ± 681.5	33.7%	0.000	18.2 ± 6.9	24.3 ± 5.4	33.8%	0.000
M, n=21	1392.7 ± 523.7	1918 ± 713.4	37.7%	0.001	18.55 ± 6.9	25.2 ± 5	36.1	0.000
F, n=16	1494.8 ± 552.9	1927.6 ± 644.7	28.9%	0.000	17.69 ± 7	23.1 ± 5.8	30.6%	0.004
4th Grade	PB	Traditional	Difference	*P*-value	PB	Traditional	Difference	*P*-value
All, n=40	1630 ± 710	1973.3 ± 836.9	21.1%	0.002	19.6 ± 5.7	23.7 ± 5.3	20.9%	0.000
M, n=21	1691.8 ± 821.8	1967.5 ± 712.5	16.3%	0.034	19.3 ± 6.1	23.6 ± 5.9	22.7%	0.000
F, n=19	1562.4 ± 562.4	1980 ± 967.3	26.7%	0.024	19.89 ± 5.3	23.7 ± 4.6	19.1%	0.00
3rd Grade	PB	Traditional	Difference	*P*-value	PB	Traditional	Difference	*P*-value
All, n= 15	1516.2 ± 562.6	1823.1 ± 679.3	19.5%	0.007	16.9 ± 6.8	20.4 ± 6.8	21%	0.002
M, n=8	1625.6 ± 589.9	2007.4 ± 746.8	23.5%	0.048	16.6 ± 7.8	21.5 ± 6.2	29.7%	0.002
F, n=7	1417.3 ± 523.4	1601.9 ± 524.4	13%	0.057	17.1 ± 5.8	19.1 ± 7.4	11.3%	0.241

Note: Averages are displayed with standard deviations. PB is the experimental condition and Traditional denotes the control condition . Difference represents the percentage change in averages seen in the experimental condition compared to the control condition . Decimals rounded to the nearest tenth. *P*-value < 0.05 = statistically significant difference between conditions . M = males, F = fe males.

Discussion

The results of this study indicate the changes of class time physical activity levels for children participating in PB activities in grades three, four, and five. The acceptability of students' in-class physical activity levels depends on their out-of-class activity levels for that day. A student who is on the low end for class time physical activity can still be healthy, provided they engage in activity throughout the day. As previously stated, the 2018 National Advisory Committee guideline calls for 60 minutes of moderate to vigorous activity per day. Given the amount of time most students participate in physical education class each day is less than 60 minutes, an initiative to participate in activity outside of class is imperative. Encouraging individualized outside physical activity is a fundamental part of the PB curriculum. This individualized activity is promoted by teaching the value of health-related concepts through specific activities that require more explanation than a traditional activity that is done for the sole purpose of exercise. Because of the complexity of the concepts and the importance of student understanding, PB activities take more time to explain to students during class, taking away valuable time that students are not being physically active during class. Results showed that students were not as physically active in classes that used a PB activity as they were when a traditional activity was played. This class time is sacrificed with the hopes that it promotes and encourages additional physical activity outside of class time. The results of this study concur with findings of researchers who conducted a meta-analysis of 31 peer reviewed pedometer activity studies with youth subjects from various countries (Tudor-Locke, McClain, Hart, Sisson, & Washington, 2009). The main findings indicated that for both genders, the younger students accumulated less steps daily than their older peers. They also determined that between the start of schooling and adulthood, boys tend to have more steps than their female peers; however, those amounts continue to decline from 6-18 years of age. The content of the meta-analysis was split into seven categories, one of which outlined findings regarding steps accumulated during physical education class. The authors reported that for boys, about 8.7 - 23.7% of steps are taken during physical education class compared to 11.4 - 17.2% reported for girls. Because students are not likely to reach their daily activity guideline from physical education class alone, physical education teachers must ensure students understand and value the health benefits of meeting the physical activity guideline each day. The PB curriculum is designed to promote this concept, where an understanding of fitness induced health leads to a life-time of choices that foster it (Hartman, 2001; Watson, 2011).

Many studies have attempted to establish the best physical education curriculum to improve students' intrinsic motivation towards reaching daily activity guidelines for health within and outside of the physical education (Green, 2004; Bocarro, Kanters, Casper, & Forrester, 2008; Petrie & Clarkin-Phillips, 2018). All of these studies indicated that students are most likely to value physical activity when they are given some degree of freedom/choice with what activity they participate in and when. The authors also stated that the physical activity should be self-initiated over a wide range of movements, not just traditional sports, and students should be encouraged to practice and self-asses their improved skill within the activity.

Over emphasis of sport and traditional games in physical education curriculums can promote lifelong fitness in some individuals but not others. Although many of the movement skills learned in childhood physical education are applied in contexts of competitive sport, not every student is interested in sport and therefore lessons in physical education should not centralize solely on traditional sport activities. According to the PB Teacher's Guide by AAPHERD (2011), a physical education program that prepares children for healthy lives must be more than traditional roll-out-the-ball programs, and the PB curriculum goal is to help students become independent in their pursuit of health through physical fitness. They achieve this goal by creating ways to educate students regardless of athletic ability or physical disability, where perhaps only the most physically proficient students receive benefits from traditional sport centralized physical education. Further sport inclusion may not be necessary because sport emphasis is heightened in secondary physical education and sport participation is increasingly found outside of school (Green, 2004). The PB activities used in this study were not traditional sport activities or games derived from sport skills. Overall, the PB activities used in this study provide a curriculum based on health-related concepts and development of basic locomotor skill activities, unlike the traditional sports skills development model. These activities provide more consistency in activity outcomes compared with some sport activities where the most athletic students are dominant contributors to the game; thus, obtaining more of the health benefits from the activity, when it is likely their less athletic peers who need those benefits most.

The PB curriculum is facilitated by the physical education teacher alone, with a focus in the gymnasium and outside of the school day. School wide initiative programs focused on physical activity include the entire school day and involve multiple teachers, staff, and parents. According to a meta-analysis by Hills, Dengel, and Lubans, (2015), school administrators can set an initiative for increased physical activity with a comprehensive school physical activity program (CSPAP). Alternative to the fitness education emphasis of PB, the goal of a CSPAP is to provide students more physical activity time. The program serves to teach all faculty physical activity inclusion for their daily lessons as well as physical activity promotion through their own participation in exercise and involvement in school sport activities. Family members are encouraged to get involved by volunteering for school sports and attending special weekend events that involve physical activity. For program compliance, physical education teachers set goals for students to be active 50% of class time each day. Also, they set goals for minutes of weekly activity in class (elementary: 150 minutes/week, secondary: 225 minute/week). With regards to the physical education component of these programs, the authors provided discussion that aligns with PB ideology. Although they believe lesson quality is partially determined by activity levels, a necessity to develop behaviors that promote activity beyond the school setting is also expressed. The authors also reported fitness knowledge through goal-setting and self-monitoring to be important components of physical education lessons. Interestingly, they did not include increased instruction time for fitness education as a barrier to promotion of physical activity through their program. Rather, they reported the recent curricular decrease

of physical education allotment in the school day as the biggest barrier to physical activity promotion. Similar to PB curriculum, the results of CSPAP meta-analysis by Hills and colleagues (2015) supports the ideology of fitness knowledge and goal setting in physical education. However, they do not acknowledge that fitness education may take away from activity time if it is to be achieved during physical education class.

The main purpose of physical education classes should be to promote lifelong physical activity. In a professional paper presented by Corbin (2002), he outlines that this lifelong physical activity objective is consistently regarded within many national guidelines and studies regarding youth physical education class. The PB activities used in the present study promote lifelong physical activity of students by educating them on health benefits accrued from exercise and how to independently structure activity and continually receive those benefits. Corbin (2002) agrees that learned skills of self-assessment, self-management, and problem-solving are high order objectives for lifelong physical fitness as opposed to low order objectives of performing exercise and becoming fit. In Leonetti, Zhu, and Chen's (2017) study of seventh grade physical education students (11-13 years), two groups were formed to complete 10 lessons from different curricula. Those who experienced a PB curricula improved more between a written pre- and post- test on health-fitness-concepts than those who experienced traditional curricula. The PB group also reported a higher perceived important value for health and fitness in a post-experiment questionnaire. The results of this study illustrated that the enhanced understanding of physical fitness and health for young people engaged in PB. In a study where an afterschool program with 24 students aged 11-12 used fitness tracking watches similar to the ones used in the present study, the knowledge of their activity levels served as a motivator to be more active in their free time (Schaefer, Ching, Breen, & German, 2016). Therefore, it appears that students who understand the incidences of the body during exercise tend to better appreciate and desire the benefits.

If fitness concepts knowledge serves to motivate young people to participate in exercise, then one could surmise that children in the best shape have the best understanding of fitness concepts. Chen and Gu (2018) used the measurements of middle school students' (*N*: 343, Age: 11 to 14 years) fitness levels and physical activity and fitness (PAF) knowledge via FitnessGram and PE Metrics(tm), respectively. They concluded that students who demonstrated healthy levels of cardiovascular fitness showed significantly higher levels of PAF knowledge than who displayed unhealthy cardiovascular fitness. In a similar study, authors also used a PAF knowledge test by PE Metrics to test 569 (300 girls, 269 boys) fourth to sixth grade students from three inner-city Title 1 schools (Brusseau, Burns, & Hannon, 2016). They also had the students complete a 20-m Progressive Aerobic Cardiovascular Endurance Run (PACER), 5 -day pedometer assessment, and BMI test. The authors reported that although statistically insignificant, increases in PAF knowledge were trending towards correlation with increases in PACER and pedometer scores. There were no relationships reported for BMI and knowledge. The researchers reported contradiction between results of their study and similar work by others, who indicate stronger relations between PAF knowledge and fitness measures. They attributed this to low PAF scores (Mean: 38%) displayed by students which could be due to their physical education class structure that only met once per week and was taught by paraprofessionals with no physical education specialization. The research of others, combined with the ideology of the PB curriculum, indicates that physical activity accrued in class does not predict lifelong physical fitness in youth. A more accurate predictor is the individual's knowledge of health-fitness benefits and skills for independently obtaining those benefits for themselves over a lifetime. Perhaps teachers could use the same PB activities several times in a row, to not only ensure that the health-related concept being taught is actually learned, but also to limit the amount of time it takes to explain the activity each day and potentially increase the student in-class physical activity time.

Limitations

Several limitations exist throughout this study. Future research should focus on effects of long term implementation and learned effects. This study did not collect data outside of school in order to measure the main goal of PB, independent and life-long physical activity. A mixed methods approach would have been helpful, where students complete a survey outlining their thoughts of PB activities and whether or not it changed their outlook on independent and life-long physical activity. Finally, future research comparing results and the content area of PB activities can help delineate between what concepts are most impactful and at what age.

Conclusion

Overall, the elementary school students in this study recorded, on average, fewer movements and spent less time in their target heart rate zone during PB activities than in their traditional activities. The results of this study proved that activity level differences were significant for all groups, except the third grade girls (9-10 years). The third grade girls were the least active group during traditional warm-up days. The results were similar to other studies in that youth boys are more active than girls of the same age, and older students are more active than their younger counterparts. Although the activity levels in class decreased with PB inclusion, the national guideline for physical activity is 60-minutes/day, which students likely will not reach in their daily physical education class regardless of content. The necessity for student exercise participation outside of class is apparent, PB curriculum is designed to foster outside of class activity through education of health concepts. Compared to traditional sport activities that motivate only the most athletic class members, the PB activities include movements that can be adapted to challenge students of all ability levels while promoting self-assessment and understanding of fitness at all stages. In support of the PB ideology, research suggests that students who are educated about their own fitness outcomes will be more motivated to independently reach activity guidelines each day outside of class.

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