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## **Participation Motives in Leisure Center Physical Activities**

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### **ABSTRACT**

This study examined whether participation motives in leisure center physical activities differ at three times of the day. A total of 450 adults, participating in Nottingham (UK) city council-managed leisure center activities, completed the Participation Motives Inventory (Gill, Gross, & Huddleston, 1983). An equal number of participants were tested in the morning (9-13 h), in the afternoon (13-17 h), and in the evening (17 -21 h). A factor analysis resulted in eight factors (motives): Team Orientation, Fitness Orientation, Achievement Orientation, Extrinsic Factors, Miscellaneous, Avoidance of Boredom, Popularity, and Self-Improvement. The afternoon sample did not differ on any of these motives from the morning and evening samples. The latter two, however, did differ on Achievement Orientation and Extrinsic Factor that were rated higher by the morning than the evening participants, whereas the evening participants rated Self-Improvement higher than the morning sample. These results warrant further systematic research to address some of the different participation motives of people attending leisure centers at different times of the day.

### **Introduction**

Understanding people's motives for involvement in physical activity sheds light on individuals' decision process for taking part in sport and physical activities (Morgantown, 2001). Therefore, determining these motives could assist in planning, promoting, and maintaining people's participation in physical activities (Ashford, Biddle, & Goudas, 1993). Indeed, the optimal motivation for participation in (and adherence to) physical activity is most likely to occur when the providers are able to identify and address the needs of the participants (Ashford et al., 1993).

The extant literature examining participation motives in physical activities is largely based on studies with children (Gill, Gross, & Huddleston, 1983; Gould, Feltz & Weiss, 1985a; Wankel & Kreisel, 1984; Wang & Wiese-Bjornstal, 1996). Most of this literature shows that children participate in sports and physical activities for clearly identifiable reasons, including skill acquisition and mastery, achievement and status, competition, energy release, sheer enjoyment or having fun, challenge, friendship or affiliation, and physical fitness (Gill et al., 1983; Wankel & Kreisel, 1984; Gould et al., 1985; Klint & Weiss, 1986; Wang & Wiese-Bjornstal, 1996).

Research into adults' motives for participation in physical activities has also identified several reasons. While most studies confirm that fitness benefits are among the main reasons, other motives for participation in physical activity include weight control, competition, sheer enjoyment, physical appearance, self-presentation, coping with stress and/or anxiety, relaxation, social contact, and fun (Cash, Novy, & Grant, 1994; Dwyer, 1992; Flood & Hellstedt, 1991; Frederick & Ryan, 1993; Gauvin, 1990; Gill & Overdorf, 1994; Leary, 1992; Silberstein, Striegel-Moore, Timko, & Rodin, 1988). These reasons vary across segments of the population. For example, Brodtkin and Weiss (1990) found multiple different motives for participation in competitive swimming between six age groups (6 to 9, 10 to 14, 15 to 22, 23 to 39, 40 to 59, and 60 to 74) by using a modified version of the Participation Motives Inventory (PMI; Gill et al., 1983). Also, Ashford et al. (1993) found sex and age differences in adults' exercise participation motives in six leisure centers. Furthermore, Ebbeck, Gibbons, and Loken-Dahle (1995) used an interactional approach to show that sex differences in participation motives depend upon the type of physical activity. However, research to date has ignored the time of the day as a potential mediating variable related to personal preferences and predispositions as well as to situational determinants (e.g., work or school commitments) that could affect one's motive for participation. The rationale for pursuing this issue is based on substantial evidence, derived from the research area of chronopsychobiology, showing that psychophysiological arousal, mood, exercise performance, and perceived exertion vary significantly in function of the time of the day (Atkinson & Reilly, 1996; Gauvin, Rejeski, & Reboussin, 2000; Winget, DeRoshia, & Holley, 1985). These factors could influence both the motives and the motivation for participation in physical activities in addition to a number of situational factors.

Research into participation motives for physical activity could assume two paths. The first, and most important from a scientific perspective, is based on theory (Zahariadis & Biddle, 2000). The second, and more important from a practical point of view, is based on applied research. The current inquiry, being exploratory in nature, adopted the later approach to identify adults' physical activity participation motives at council-managed leisure centers in the UK with a special focus on the possible differences that may occur in relation to the time of the day. The rationale for such an investigation could be justified by both personal (e.g., preference) and situational (e.g., commitments) factors that could affect motivation for participation at different times of the day as well as by the existing circadian fluctuations in arousal, mood and performance (Atkinson & Reilly, 1996; Gauvin, Rejeski, & Reboussin, 2000; Winget, DeRoshia, & Holley, 1985).

## Results

### Importance Ratings

Table 1 shows the average scores for each of the 30-items being considered as the most important by the 450 participants. The item "to get exercise" received the highest rating ( $M = 1.22$ ) followed by "to be physically fit" ( $M = 1.27$ ), and "to stay in shape" ( $M = 1.27$ ). These results were also consistent when analyzed separately for the time of the day (i.e., morning, afternoon, and evening).

<u>Table 1. Mean "most important" ratings of the PMI items</u>			
	Reasons	<i>M</i>	<i>SD</i>
1..	To get exercise	1.22	.47
2.	Stay in shape	1.27	.51
3.	To be physically fit	1.27	.52
4.	To have fun	1.38	.60
5.	To have something to do	1.64	.66
6.	Do something good at	1.67	.69
7.	To release tension	1.68	.69
8.	To get out of the house	1.71	.70
9.	Like the action	1.77	.70
10.	To use equipment/facilities	1.78	.66
11.	Like the rewards	1.81	.74
12.	Like the challenge	1.82	.71
13.	Improve skills	1.97	.71
14.	Like the excitement	1.97	.70
15.	Meet new friends	2.04	.68
16.	Be with friends	2.05	.75
17.	Learn new skills	2.08	.70

18.	Like the team spirit	2.13	.76
19.	To compete	2.18	.74
20.	Get rid of energy	2.19	.74
21.	Like the teamwork	2.23	.75
22.	Go onto a higher level	2.27	.72
23.	Like being on a team	2.31	.70
24.	Like to Travel	2.36	.74
25.	Like to win	2.37	.72
26.	To feel important	2.48	.62
27.	To be popular	2.55	.60
28.	Parents/friends want me to	2.58	.66
29.	Like the instructor	2.58	.67
30.	To gain status	2.70	.56

### Factor Analysis of the PMI

The second step of analysis was to identify underlying dimensions for adults' motives for participation in leisure center activities. Principle component analysis, with varimax rotation and Kaiser normalization procedures, was performed by using the responses from the 30 items of the PMI (Field, 2000). Only those factors with eigenvalues of 1.0 or higher were retained for the final rotation (Zahariadis & Biddle, 2000). As expected on the basis of the study by Gill et al. (1983), eight factors, which accounted for 60.5% of the total variance, were identified (Table 2). A minimum loading of 0.40 was used for the inclusion of an item on a particular factor (Zahariadis & Biddle, 2000). Using this criterion, four items were "complex", loading on more than one factor: to travel, to meet friends, to go onto a higher level, and to be popular.

Table 2. Factor loading of PMI

Reason	Factor 1 Team Orientation	Factor 2 Fitness Orientation	Factor 3 Achievement Orientation	Factor 4 Extrinsic Factors	Factor 5 Miscellaneous	Factor 6 To Avoid Boredom	Factor 7 Popularity	Factor 8 Self- Improvement
team spirit	.829							
teamwork	.817							
going on a team	.717							

excitement	.493							
to take the action	.476							
to be physically fit		.819						
to stay in shape		.729						
to get exercise		.435						
to win			.725					
to compete			.713					
to go to a higher level			.477				.442	
to challenge			.441					
to get rid of energy			.433					
to feel important				.676				
to do something I am good at				.595				
to be popular				.560			.446	
because of parents/close friends				.533				
because of the rewards					.728			
to release tension					.663			
to use the equipment facilities					.448			
to get out of the house						.727		
to do something						.661		
to have fun						.543		
to be with friends						.512		
to gain status/recognition							.738	
because of the instructor							.648	
to improve skills								.689
to learn new skills								.678
to meet new friends	.450							.487
to travel				.420				.439

Generally, the individual items were grouped together in logical factor patterns. Factor 1 accounted for 23.8% of the variance, which included items that represented "Team Orientation". Specific reasons for high factor weights on Factor 1 were team spirit, teamwork, being on a team, excitement, to meet new friends, and action (23.8% of variance). Factor 2 accounted for 8.9% of variance and was labeled "Fitness Orientation" (stay in shape, physically fit, and to get exercise) whereas Factor 3 dominated "Achievement Orientation" for reasons of to win, go onto a higher level, challenge, compete, and to get rid of energy (6.9% of variance). Factor 4 loaded heavily on reasons to be noticed and was labeled "Extrinsic Factors" consisting of the reasons of to feel important, do something I am good at, be popular, travel, and because parents or close friends want me to (5.5% of variance). Factor 5 was labeled "Miscellaneous", of which included reasons were rewards, to release tension, and use the equipment (5.1% of variance). Factor 6 represented reasons "To Avoid Boredom" including items of to get out of the house, to have something to do,

fun, and to be with friends (3.6% of variance). Factor 7 held items of gaining status /recognition, such as to be popular, go onto a higher level, and like the coach/instructor, and it was labeled "Popularity" (3.5% of variance). Last, Factor 8 loaded heavily on "Self-Improvement" for reasons of to meet friends, travel, to improve skills, and to learn new skills (3.4% of variance).

To further explore the reliability of the eight factors gained with the above analysis, three other separate principal component analyses were performed for the morning, afternoon, and evening sub-samples ( $n = 150$  in each). These tests showed that five of the eight factors from the global analysis also emerged in this time of the day analyses. These factors were: Team Orientation, Achievement Orientation, Fitness Orientation, Extrinsic Factors, and To Avoid Boredom. The Miscellaneous category (Factor 5) from the global test has also emerged from both the morning and the afternoon sample's data while Popularity and Self-Improvement could only be justified in morning.

The results of an internal consistency analysis on the PMI are presented in Table 3. Factor scale reliability was determined by computing the reliability coefficient (Field, 2000) Cronbach alpha ( $\alpha$ ), which ranged between .62 and .83 (These values are greater than the internal consistencies reported by Gill et al. (1983) for the eight factors obtained with young participants). The internal consistencies for all factors were moderate to high. The factor structure observed here was similar to those reported by previous researchers that have used the PMI to deduce youth participation motivation, with the addition of one new factor (Table 6) labeled "To Avoid Boredom".

Table 3. Factor structure and internal consistency	
Factor	Cronbach Alpha
Team orientation	.83
Fitness orientation	.72
Achievement orientation	.75
Extrinsic Factors	.62
Miscellaneous	.61
To Avoid boredom	.60
Popularity	.63
Self improvement	.62

Differences in participation motives at various times of the day

To determine whether participation motivation was different in the morning, afternoon, and evening, factor scores were created for each respondent's responses on all derived factors. These factor scores became the dependent measures in a sex by time multivariate analysis of variance (MANOVA). This analysis yielded significant main effect for time  $F(16, 876) = 1.94, p = .05$ , and for sex  $F(8, 437) = 10.15, p = .001$ . Follow-up univariate F-tests revealed that the time main effect was due to significant differences in achievement orientation  $F(2, 447) = 3.92, p = .05$ , Extrinsic Factors  $F(2, 447) = 3.93, p = .05$ , and Self-Improvement,  $F(2, 477) = 3.91, p = .05$ . The first two were stronger motives in the morning while the last was more important in the evening. Discriminant function coefficients were also adopted to examine the results of the univariate follow-up analyses, because they are thought to be more reflective of the multivariate contributions of individual factors (Wang & Wiese-Bjornstal, 1996). Considering the criterion loading of .40 as significant, the discriminant function analysis results were consistent with the univariate tests (Table 4). In both functions, Achievement Orientation, Extrinsic Factors, and Self-Improvement characterized the primary motives that differentiated between the morning, the afternoon, and the evening samples.

Factor	Univariate- $F(2, 477)$	Standard Discriminant Function Coefficient	
		Function 1	Function 2
Achievement orientation	5.01*	.587	-.659
Extrinsic Factors	4.99*	.578	.758
Self improvement	3.87*	-.533	.096
Popularity	2.22	.014	-.005
Fitness orientation	.442	-.010	.001
Team orientation	.317	.009	.000
To Avoid boredom	.202	.007	.000
Miscellaneous	.132	.003	-.001
* $p = .05$			

The univariate follow-up tests for the sex main effect revealed significant differences in three factors: Achievement Orientation  $F(1, 448) = 60.9, p = .001$ , Extrinsic Factors  $F(1, 448) = 4.23,$

$p = .05$ , and To Avoid Boredom  $F(1, 448) = 5.72, p = .05$ . Women gave higher ratings than men to the motives of "Achievement Orientation" and "Extrinsic Factors", whereas men rated higher than women the motive "To Avoid Boredom". Discriminant function coefficients were also calculated and these were consistent with the univariate follow-up tests (Table 5).

Table5. Sex main effect: follow-up analyses.		
Factor	Univariate - $F(1, 448)$	Standard Discriminant Function Coefficient
Achievement orientation	60.9 ***	.90
To Avoid boredom	5.72 *	-.28
Extrinsic Factors	4.23 *	.25
Miscellaneous	2.28	.03
Fitness orientation	1.33	.02
Popular status	1.1	.02
Team orientation	.18	.00
Self improvement	.03	.00
* $p = .05$ , *** $p = .001$		

## Discussion

This study found that people participate in leisure center activities for fitness reasons and less so for ego or popular status. The most highly rated motives for adult participation was to get exercise, to be physically fit, and to stay in shape. It was also found that these motives were stable over the course of the day. These findings corroborate previous studies that have revealed that health and fitness are the main incentives for adults' involvement in physical activity (Adamson & Wade, 1986; Ashford et al., 1993; Brodtkin & Weiss, 1990).

The current results could only be closely compared to those obtained by Ashford et al. (1993), in a study that also examined an adult population participating in leisure center-offered physical activities. In contrast to four motives disclosed by Ashford et al. (1993), this study found eight motives for adult participation motivation in leisure center activities (Table 6). Therefore, the current findings both agree and expand on the study done by Ashford et al. (1993) almost 10 years ago. They agree with their findings because four out of the eight factors identified in this study were similar to the findings of Ashford et al (1993). However, there is a different pattern here. Ashford et al. (1993) found Assertive Achievement as the primary motive for adult participation, which is similar to the third motive "Achievement Orientation" in this investigation.



The second motive identified by Ashford et al. (1993) was Physical Well-being, which may be considered conceptually equivalent to "Fitness Orientation" in this inquiry. Even Ashford et al.'s (1993) Socio-Psychological Well-being may be distantly contrasted with the "Miscellaneous" category in the present study. Finally, the fourth component identified by Ashford et al. (1993) was Sports Mastery and Performance, may also be conceptually similar to factor eight, labeled "Self-Improvement", in this research. Although the four elements found by Ashford et al. (1993) were similar to four of the eight motives in the present findings, these authors did not find the other four factors that were revealed here: a) Team Orientation, b) Extrinsic Factors, c) To Avoid Boredom, and d) Popularity. One reason for this discrepancy rests with the fact that the questionnaire used by Ashford et al. (1993) only included fifteen items from which only a lesser number of factors could be derived in contrast to the 30-item PMI used here. </TR< TABLE>

Table 6. Factors identified in participation motivation studies and the present study.

Youth					Adults and youth		
Gill et al (1983)	Gould et al (1985)	Klint & Weiss (1986)	Wang & Wiese-Bjornstal (1996)	Zahariadis & Biddle (2000)	Brodkin & Weiss (1990)	Adamson & Wade (1986)	Ashford et al (1992)
Achievement/Status	Achievement/Status	Aspects of competition	Achievement/Rewards		Aspects of competition		Sports mastery and performance
Team	Team atmosphere	Team atmosphere	Team orientation	Team atmosphere			
Fitness	Fitness	Fitness	Fitness	Fitness	Health/Fitness	Health	Physical well-being
Energy release	Energy Release		Energy release	Energy release	Energy release		Socio-psychological well-being
Others					Significant others		
Skill	Skill development		Competence/	Skill / Competition			

			Competition				
Friends	Friendship		Friendship	Affiliation	Affiliation		
Fun			Fun/ Excitement		Fun		
	Excitement/ Challenge	Challenge					
		Action					
		Situational					
		Social recognition	Social activity		Social status	Social	
			Future career pursuits				
			Family influence				
							Assertive achievement
				Status/ recognition			


A note on Factor 1 (Team Orientation), that explained 23.8% of the variance, ought to be added. The participants in this study were not involved in team-sports but in leisure center activities, that although take place in a social setting are co-active in nature rather than task-interactive. Therefore, although labeling it as Team-Orientation here to match closely the included items, we suspect that this motivational orientation could reflect a combination of social affiliation and social (but not task) interaction. It is very difficult to untangle the dilemma of conceptual accuracy versus semantics in this kind of investigation. A summary table reflecting this issue is shown in Table 6.

Seven out of eight motivational categories exposed via the eight factors found with the PMI in this study, agree with previous research with children or adults (Table 6). One motivational category, To Avoid Boredom, was not identified in previous research. One possible, yet speculative, reason may be that the current sample could have included a large number of unemployed people for whom the council-managed leisure centers are both convenient to avoid boredom and affordable in terms of financial cost. Because no demographic data were obtained from the participants, regrettably, such an explanation remains tentative.

The key contribution of this exploratory research, the identification of several different motives for participations in the morning in contrast to the evening, may also corroborate the above explanation. Specifically, it was found that "Achievement Orientation" and "Extrinsic Factors" were more important motives for the morning than the evening participants. Clearly both achievement and worthiness are part of the above constructs. It is also logically possible that a larger proportion of the morning participants were unemployed. If so, their participation motive could reflect a need to compensate for some negative psychological consequences of unemployment through some alternative (than work) achievements and worthiness. While this explanation is highly tentative, it generates a hypothesis that deserves testing in future research. The leisure and/or sport centers, offering opportunities for physical activity to the public, could then address these diurnal differences in participation motives.

While morning participants' focus was more "Extrinsic Factors" the participants in the evening differed from them on the "Self-Improvement" motive (Factor 8; Table 2). The two most contributing items to this motive were to improve my skills and to learn new skills, which reflect task-orientation-related interests. Consequently, these results provide an incentive for the further examination of this issue not only from an applied but also from a theoretical perspective, such as the goal orientation theory adopted by Zahariadis and Biddle (2000) in their study with schoolchildren.

In line with the extant literature, motivational differences were found between males and females (Ashford et al., 1993; Ebbeck et al., 1995; Koivula, 1999). Women rated Achievement

Orientation and Extrinsic Factors as more important than men, while men rated Factor 6 (To Avoid Boredom) more important than women. When comparing these findings to the study by Ashford et al. (1993), the current results are different in that women here were more motivated to achieve than men who strived to avoid boredom more than women. However, in the Ashford et al. (1993) study men were more motivated than women to participate in leisure center activities for mastery and performance, and assertive achievement. Such results could reflect changes in the participation motives, at a social level, that took place in the past decade. Women may be more achievement-motivated today than men, at least when participation motives for leisure center physical activities are contrasted between the two sexes.

The key contribution of this exploratory research, in addition to the identification of the principal participation motives in leisure center physical activities, is the disclosure of differences in participation motives in the morning and the evening. Therefore, these modest but important data raise a question mark on the reliability and/or limitations of previous research in this area. On the other hand, this study has its shortcoming too that future research needs to observe. For example, demographic variables, especially working status of the participants, needs to be established. Further, age was not taken into consideration and frequency of participation was not assessed. Finally, some items even after rerunning the factor analysis several times could only be classed within "unfitting" categories, like liking the rewards (Miscellaneous) and liking the instructor (Popularity). In conclusion, the generalizability of these findings may be questionable, because the study was performed in a specific geographical region and in specific council-managed leisure centers. However, in line with the initial hypothesis, derived on the bases of known circadian fluctuations in psychophysiological parameters and different social aspects of the every day life, this study shows quite clearly that motivational incentives may also fluctuate as function of the time of the day, which is a modest but important conclusion that cannot be overlooked in future research in this area.

## References

- Adamson, B., & Wade, K. (1986). Predictors of sport and exercise participation among health science students. Australian Journal of Science and Medicine in Sport, 18 (4), 3-10.
- Ashford, B., Biddle, S., & Goudas, M. (1993). Participation in community sports centres: Motives and predictors of enjoyment. Journal of Sports Science, 11(3), 249-256.
- Atkinson, G., & Reilly, T. (1996). Circadian variation in sports performance. Sports Medicine, 21 (4), 292-312.
- Brodkin, P., & Weiss, M.R. (1990). Developmental differences in motivation for participating in competitive youth swimming. Journal of Sport and Exercise Psychology, 12 (3), 248-263.
- Cash, T.F., Novy, P.L., & Grant, J.R. (1994). Why do women exercise? Factor analysis and further validation of the reasons for exercise inventory. Perceptual and Motor Skills, 78, 539-544.
- Dwyer, J.J.M. (1992). Internal structure of participation motivation questionnaire completed by undergraduates. Psychological Reports, 70, 282-290.
- Ebbeck, V., Gibbons, S.L., & Loken-Dahle, L.J. (1995). Reasons for adult participation in physical activity: an interactional approach. International Journal of Sport Psychology, 26, 262-275.
- Field, A. (2000). Discovering Statistics Using SPSS for Windows. London: SAGE.
- Flood, S.E., & Hellstedt, J.C. (1991). Gender differences in motivation for intercollegiate athletic participation. Journal of Sport Behavior, 14, 159-167.
- Frederick, C.M., & Ryan, R.M. (1993). Differences in motivation for sport and exercise and their relations with participation and mental health. Journal of Sport Behavior, 16, 124-146.
- Gauvin, L. (1990). An experiential perspective on the motivational features of exercise and lifestyle. Canadian Journal of Sport Sciences, 15, 51-58.
- Gauvin, L., Rejeski, J.W., & Reboussin, B.A. (2000). Contributions of acute bouts of vigorous physical activity to explaining diurnal variations in feeling states in active, middle-aged women. Health Psychology, 19 (4), 365-375.
- Gill, D., Gross, J., & Huddleston, S. (1983). Participation motivation in youth sports. International Journal of Sports Psychology, 14 (1), 11-14.
- Gill, K., & Overdorf, V. (1994). Incentives for exercise in younger and older women. Journal of Sport Behavior, 17, 87-97.
- Gould, D., Feltz, D., & Weiss, M.R. (1985a). Motive for participation in competitive youth

swimming. International Journal of Sport Psychology, 16 (2), 126-140.

Gould, D., Feltz, D., Weiss, M.R. (1985b). Reasons for attrition in competitive youth swimming. Journal of Sport Behavior, 5, 155-165.

Klint, K.A., & Weiss, M.R. (1986). Dropping in and dropping out: Participation motives of current and former youth gymnasts. Canadian Journal of Applied Sports Sciences, 11(2), 109-114.

Koivula, N. (1999). Sport participation: differences in motivation and actual participation due to gender typing. Journal of Sport Behavior, 22(3), 360-376.

Leary, M.R. (1992). Self-presentational processes in exercise and sport. Journal of Sport and Exercise Psychology, 14 (4), 339-351.

Morgantown, W.V. (2001). A further exploration of the involvement profiles in selected recreational sport activities: results from a study in Korea. Sport Marketing quarterly, 10 (2), 77-82.

Silberstein, L.R., Striegel-Moore, R.H., Timko, C., & Rodin, J. (1988). Behavioral and psychological implications of body dissatisfaction: Do men and women differ. Sex Roles, 19, 219-232.

Wang, J., & Wiese-Bjornstal, D.M. (1996). The relationship of school type and gender to motives for sport participation among youth in the People's Republic of China. International Journal of Sport Psychology, 28 (1), 13-24.

Wankel, L.M., & Kreisel, S.J. (1985). Factors underlying enjoyment of youth sports: Sport and age group comparisons. Journal of Sport Psychology, 7 (1), 51-64.

Winget, C.M., DeRoshia, C.W., & Holley, D.C. (1985). Circadian rhythms and athletic performance. Medicine and Science in Sports and Exercise, 17 (5), 498-516.

Zahariadis, P.N., & Biddle S.J.H. (2000). Goal orientations and participation motives in physical education and sport: their relationships in English schoolchildren. Athletic Insight: The Online Journal of Sport Psychology. Retrieved May 5, 2001 from [http://www.athleticinsight.com/Vol2Iss1/English\\_Children.htm](http://www.athleticinsight.com/Vol2Iss1/English_Children.htm).

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