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Adult Sports Participation and Physical Activity: How About Curling?

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Abstract

Despite its well-documented physical and psychosocial benefits, sport remains the least engaged form of physical activity (PA) among adults. Many adults may lack the skills needed to play or continue to play sports and aging adults are more likely to avoid participation for fear of poor performance or injury. A sport that shows great promise for adults seeking new sports participation outlets is curling. Curling is a team sport comprised of four interchangeable positions working collectively to deliver granite stones across a sheet of ice in an effort to outscore the opponent team. While it seems reasonable that walking on ice, "throwing" a 44 lb granite stone across a sheet of ice, and periodically sweeping while walking on ice over a two-hour period would generate at least a moderate amount of physical activity, research to date is quite limited. Therefore, the purpose of this study was to objectively measure the amount and intensity of PA achieved by average recreational curling participants during a typical curling match. Members of a curling club in NC were asked to wear ActiGraph Accelerometers (model GT3X) while they participated in their regularly scheduled curling match. All participants had at least one year of curling experience. Curling matches lasted between 90 and 120 minutes. Participants were asked to indicate their age, gender, and curling position during the match (lead, second, vice, skip) which were matched with accelerometer data. Overall, 110 participants (37 female, 73 male, avg. age 50 yrs) spent most of their curling time in light or moderate-intensity activity (18.1% Sedentary; 49.5% light; 32.4% moderate; .03% vigorous). In terms of minutes, the average participant spent 35.9 minutes engaged in Moderate-to-Vigorous PA (MVPA) per curling experience. This represents 23.9% of the weekly 150min of MVPA suggested by the CDC. Estimates of METs indicated that curling would be classified on the border of light and moderate physical activity. While total step data indicated that participation in beginning curling could make a significant contribution toward meeting the 10,000 – 13,000 daily step recommendation with an average of 2936 steps (~30%) within the curling sessions. The second position had the highest percentage of moderate activity level and a small percentage of vigorous activity. No other position reached a vigorous level. The skip position had the highest amount of sedentary activity as well as light activity. Females had a higher level of moderate activity in comparison to males. However, males reached a small amount of vigorous activity. The age group of 18 - 36 had the highest amount of moderate activity and the lowest amount of sedentary activity. This age group reached an average of 41.0 minutes of MVPA per curling experience. The age group of > 58 had the highest amount of sedentary activity and the lowest amount of moderate activity. Findings clearly show that regardless of position, curling participants achieved a moderate amount of physical activity during typical gameplay and that a majority of playing time was spent engaged in light or moderate levels. Participants should consider playing in one of the first three positions to maximize the amount and intensity of PA achieved while playing. Furthermore, since curling also requires balance, coordination, muscular strength, multitasking, strategic reasoning, and can cater to most physical challenges without compromising the integrity of the game, it may be an ideal sport to promote for adults of all ages and sport abilities. Findings should be used to inform strategies for promoting curling as an opportunity for team sport involvement that has the added value of contributing to daily physical activity. However, access and opportunities to play, especially for underserved populations, are limited. Given that most curling clubs in America are private and require a membership to play (Kanters, et. al, 2023), partnership arrangements between existing clubs and public parks and recreation departments could increase both access and opportunities to play.

The benefits of physical activity (PA) for adults of all ages are well established. However, most research has focused on physical activity in general rather than the context in which activities occur. Sustained adherence to physical activity behaviors is more likely to persist over time when associated with behaviors like sports that include other psychosocial benefits (Fife-Schaw et al., 2014). Despite its well-documented physical and psychosocial benefits, sports remain the least engaged form of PA among adults (Eime et al., 2016; Physical Activity Council, 2018; Van Tuyckom, Scheerder, & Bracke, 2010). While most research indicates that participation in sports declines with age, some studies have reported that leisure-time physical activity may increase with age for some groups of men and women and that sports organizations should promote participation regardless of a participant's prior sports involvement (Jenkin, Eime, Westerbeek, O'Sullivan, & van Uffelen, 2017). However, aging adults with a desire to maintain or increase their sports participation often experience a host of barriers.

Beyond the more common barriers of time and money, many adults may lack the skills needed to play or continue to play sports. Leisure theory suggests that a perceived lack of appropriate sports skills can inhibit or prevent participation (Koeneman, Verheijden, Chinapaw, & Hopman-Rock, 2011; McPhee et al., 2016). With motor performance beginning to deteriorate at some stage in adulthood (McMorris, 2004) even adults with a diverse array of sports skills accumulated through their lifespan may resist engaging in familiar sports as they age for fear of performance failure. A key factor for enduring involvement in any leisure activity is a sense of performance competence and a moderate level of self-efficacy (Yu, & Song, 2022). While many adults may possess a repertoire of sports skills accumulated through involvement in sports as a child and young adulthood, as motor performance deteriorates so too do one's sports skills, which may compromise their perceived ability to participate.

Age stereotypes have also been identified as factors influencing individual leisure choices and behavior patterns. The stereotype embodiment theory argues that age stereotypes are internalized after repeated and consistent reinforcement throughout the lifespan resulting in a diminishing perception of capabilities with age (Levy, 2009). The result is a reduction in one's perception of their ability to engage in certain behaviors as they age (e.g., reduced self-efficacy) and fear-induced avoidance of certain activities (Liu-Ambrose, Khan, Eng, Lord, & McKay, 2004). Since all sports have a skill-based requirement for participation, aging adults are more likely to avoid participation for fear of poor performance or injury.

Access and opportunities to participate have also been reported as a barrier to sports participation among all age groups. For example, Chen et al., (2023) found that access to park and recreation opportunities was a significant predictor of older adult's participation in sports and that older adults may have fewer opportunities for sports than other age groups. This is consistent with other research that indicates access to recreation services is associated with sports participation among older adults (Sato et al., 2019; Schipperijn et al, 2017) and that a lack of senior teams/competitions, inappropriate facilities, or negligible opportunities in close geographical proximity were noted as barriers to participation (Jenkin, et al., 2017).

Moreover, the barriers to sports participation among an aging population in a culture that equates aging to a decline in physical and cognitive abilities represent a significant challenge. While the repertoire of sports opportunities certainly decreases with age, some promising developments may address a perceived lack of sports skills and the ageism dilemma. The sport of pickleball, for example, has experienced unprecedented growth across the United States over the past decade. Pickleball is a paddle sport created in 1965 that combines aspects of tennis, badminton, and table tennis (USA Pickleball Association, 2021). Although competitive, pickleball's smaller court dimensions that deemphasize athleticism relative to analogous sports such as tennis help to foster an inclusive environment that makes it attractive for participants of all ages or those having mobility limitations that would otherwise preclude these persons from social or competitive sports (Casper et al., 2023).

Another sport that shows great promise for adults seeking new sports participation outlets is curling. Curling is a team sport comprised of four interchangeable positions (the curler, the skip, and two sweepers) working collectively to deliver 44-pound granite stones across a sheet of ice in an effort to outscore the opponent team by stopping their stones as close as possible to the target house (Bradley, 2009; Steele, Johnson, & Kraft, 2014). A typical curling match will last for two hours, during which time participants often experience some level of physical activity, as well as balance, coordination, and muscular strength. Additionally, participants engage in multitasking, and strategic reasoning (Auld & Kiv, 2010; Bradley, 2009; Willoughby & Kostuk, 2005). Curling also facilitates social connectedness both within and between teams and requires a constant flow of communication among team members during the game (Leipert et al., 2011; Lethem, Slade, Troup, & Bentley, 1983). Furthermore, curling may be an ideal sport to promote for many adults since it can be easily adjusted for novices and can cater to most physical challenges without compromising the integrity of the game (Leipert et al., 2011).

While it seems reasonable to assume that walking on ice, "throwing" a 44 lb granite stone across a sheet of ice, and periodically sweeping while walking on ice over two hours would generate a reasonable amount of physical activity, research to date is quite limited. For example, although the 2011 Compendium of Physical Activity (Ainsworth, 2011) estimates that curling requires an energy output of 4.0 METs, which is similar to walking at 2.8 mph, pushing or pulling a stroller with a child, or stair climbing at a slow pace, this value is not directly derived from published research. However, in a direct study of curling participants, using accelerometers and pedometers,

Johnson, Vanbelkum, and Kraft (2018) reported that participants exerted an average of 2.1 METS and accumulated an average of 3114 steps during an 81-minute curling session. The Johnson et al. (2018) finding is not only half of that reported by the 2011 Compendium of Physical Activity; their study was limited to beginning curlers in a college curling class, which is not representative of the average recreational curling population in the United States (Kanters, Bunds, Casper, Hipp, 2023).

Stone, Gage, and Baker (2018), in their study of the psychophysical benefits of curling for older adults, found that curling participants self-reported higher levels of physical activity levels than non-curling participants using the Godin-Shephard Leisure-Time Physical Activity Questionnaire. While it could be speculated that curling was the cause of higher PA levels among curling participants in their study, no direct measures of PA during curling were collected. Finally, Auld and Kivi (2010) examined the heart rate recovery of competitive curlers after different durations of maximal sweeping effort. Their controlled experiment with eight men and seven women professional curlers (average age 24 years) found that after 25 seconds of sweeping a curling stone, the average heart rate was 90.3 BPM (SD 4.6%) and 89.9 BPM (SD 4.7%) for men and women, respectively. While this study confirms that the act of sweeping the curling stone does result in an elevated heart rate, it provides little insight into the overall amount of PA experienced by average participants during a curling match.

The purpose of this study was to objectively measure the amount and intensity of PA achieved by average recreational curling participants during a typical curling match. Additionally, similar to sports with variable position responsibilities (e.g., baseball, soccer, position matters within the context of physical activity in curling. A typical curling team includes four members, a lead, a second, a vice, and a skip. All members throw two curling stones each but walking and sweeping requirements vary by position. For example, the lead and second position are expected to sweep all three of their teammates' stones which requires walking at a fairly brisk pace alongside the stone while it travels the length of the ice (roughly 45 meters). The vice, however, only sweeps for two other team members and the skip generally doesn't sweep. Previous curling research has not included the context of position, therefore, this study's purpose extended to control for curling position when examining the amount and intensity of PA.

Although curling has experienced steady growth since its debut at the 1998 Olympics, we still know very little about the physical benefits of participation. In addition to more than doubling membership in the USA Curling Association since 1998, when TV stations started broadcasting Olympic curling matches, American viewership has also increased significantly (Tingley, 2018). According to Tingley, internationally televised competitions positively impacted the sport's popularity and the translation from sport spectator to sport participant may be attributed in part to a perception that curling is easy to play. Although research is limited, some studies have found that curling participants experience physical demands related to balance, coordination, strength, and endurance (both muscular and cardiovascular) (Auld & Kivi, 2010: Bradley, 2009; Willoughby & Kostuk, 2005). Findings from the present study would first establish a baseline for expectations about the average amount and intensity of physical activity experienced by the average recreational curling participant. Secondly, findings could be used to inform strategies for promoting curling as an opportunity for team sport involvement that has the added value of contributing to daily physical activity requirements.

Methods

Participants were 110 members of a private curling club in North Carolina (37 female and 73 male) engaged in one of the recreational curling leagues offered by the club during the 2023 curling season. A member of the research team was present for 11 league competition nights to recruit participants (capped at 15 per night due to accelerometer availability). All participants had at least one year of curling experience and agreed to participate in the study without any benefit from their participation. The study was approved by the Institutional Review Board (IRB) and NC State University (IRB #25204). Descriptive statistics are included in Table 1.

Protocol

Participants were provided a wrist-worn ActiGraph accelerometer (model GT3X) and asked to wear the monitor on their dominant wrist for the duration of their curling match. The accelerometer was placed so as not to interfere with the physical activity that occurred during normal gameplay. Time entering the ice sheet was noted. Participants then completed their curling session as normal with no intervention from the researchers. All participants were monitored for only one session which lasted approximately 105 minutes.

Upon completion of their curling match, accelerometers were retrieved by the researcher noting the time leaving the ice sheet and accelerometer serial number on a data collection form. All accelerometer data were cut to represent only time on ice. Participants were asked to indicate their age, gender, and curling position (lead, second, vice, skip) during the match. Although data collection occurred during several different curling leagues on different days of the week, each session was structured in a similar manner with the same rules and timeframe. Since study participants were adults and only participating in one sport, accelerometer cut points were set at 15 seconds epochs and used the Bammann et. al cut points for dominant wrist counts (60s): < 122 Sedentary/Light; 122-233 Moderate; >234 Vigorous.

Analyses

We primarily present descriptive statistics of physical

activity levels by gender and curling position. Where appropriate, an analysis of variance was used to assess differences in PA levels by position and gender. The curling position was identified as a predictor variable because physical movement requirements vary by each position. For example, the first (lead) and second curler on each team are expected to sweep each of their teammate's rocks while walking briskly the length of the curling sheet of ice (45 meters). The third (vice) curler only sweeps for the first and second curlers, and the fourth (skip) curler does not sweep their teammate's rocks. Therefore, from a walking distance perspective, during each curling end, a lead and second will walk approximately 270 meters, the vice will walk 180 meters, and the skip will be predominantly stationary.

Table 1. Descriptive Statistics of Study Participants by Position and Gender.

Gender	***n***	***Average Age (years)***
Male	73	51 (SD = 13.08)
Female	37	48 (SD = 12.14)

Table 2. Descriptive Statistics of Study Participants by Position and Gender.

Position	***Gender***	***n***	***Average Age (years)***
Lead	female	13	53 (SD 12.2)
	male	12	46 (SD 18.2)
Total		25	49 (SD 15.4)
Second	female	11	40 (SD 10.4)
	male	18	49 (SD 8.3)
Total		29	46 (SD 9.8)
Vice	female	9	55 (SD 9.2)
	male	19	53 (SD 14.0)
Total		28	53 (SD 12.5)
Skip	female	4	42 (SD 8.1)
	male	24	54 (SD 12.0)
Total		28	52 (SD 12.2)
Grand Total		**110**	**50 (SD 12.7)**

Results

Overall, results presented in Table 1 and Table 2 show that participants spent most of their curling time in light or moderate-intensity activity (18.1% sedentary; 49.5% light; 32.4% moderate; .03% vigorous) and that females had a higher level of moderate activity (34.58%) in comparison to males (31.31%). The results of PA comparisons across the four curling positions show that the second position had the highest percentage of moderate activity level (36.11%) and a small percentage of vigorous activity (.12%), while the skip position had the highest percentage of sedentary (19.32%) and light (52.76%) activity.

Table 3. Physical activity of curling participants by curling position by position and gender.

Position	*Gender*	Average of % Sedentary	Average of % Light PA	Average of % Moderate PA	Average of % Vigorous PA
Lead	female	17.85%	50.57%	31.58%	0.00%
	male	18.89%	48.15%	32.96%	0.00%
Total		18.35%	49.41%	32.24%	0.00%
Second	female	14.38%	45.55%	40.06%	0.00%
	male	18.89%	47.21%	33.70%	0.20%
Total		17.18%	46.58%	36.11%	0.12%
Vice	female	20.09%	48.79%	31.11%	0.00%
	male	16.42%	49.36%	34.22%	0.00%
Total		17.60%	49.18%	33.22%	0.00%
Skip	female	16.07%	46.91%	37.03%	0.00%
	male	19.86%	53.74%	26.40%	0.00%
Total		19.32%	52.76%	27.92%	0.00%
Grand Total		**18.10%**	**49.46%**	**32.41%**	**0.03%**

The results of an ANOVA of percent moderate-to-vigorous PA (MVPA; moderate plus vigorous) by position and gender was not significant for female participants, but significant for males (F=3.303, p=.025). However, Bonferroni multiple comparisons between all two-way groups were non-significant, likely due to the small sample size. Comparisons between the vice (34.22% time in MVPA) and skip (26.40% time in MVPA) positions were not statistically significant (p=.055).

An estimated MET value for the curling session was calculated using the Freedson and Sasaki equation of METS=1.439008+(0.000795* Vertical Axis Counts/minute) (Chomistek, et. al., 2017). Results ranged from 1.65 to 3.38 with an average MET value of 3.05 (SD: 0.042).

Total step data presented in Table 4 indicated that, on average, participants accomplished 2,936 steps within the curling session (average duration of 81 minutes).

Table 4. Average step counts of curling participants by position and gender.

Position	***Gender***	**Average of Steps Counts**
Lead	female	3251
	male	3078
Total		3168
Second	female	3538
	male	2923
Total		3157
Vice	female	3208
	male	3222

Total		3218
Skip	female	2110
	male	2238
Total		2220
Grand Total		**2936**

In terms of minutes, the average participant spent 35.9 minutes engaged in Moderate-to-Vigorous PA (MVPA) per curling experience. This represents 23.9% of the weekly 150 minutes of moderate to vigorous physical activity (MVPA) suggested by the CDC. The second position had the highest percentage of moderate activity level and a very small percentage of vigorous activity (Table 2). No other position reached a vigorous level. The skip position had the highest amount of sedentary time, as well as light activity. Female curlers had a higher level of moderate activity in comparison to males. The age group 34 years old and younger had the highest amount of moderate activity and the lowest amount of sedentary activity, though the only represented 8% of the sample. This age group reached an average of 41.0 minutes of MVPA per curling experience. The age group over 64 years old had the highest amount of sedentary and light activity time and the lowest amount of moderate activity.

Table 5. Physical activity of curling participants by age.

Age (n)	**Average % Sedentary**	**Average % Light**	**Average % Moderate**	**Average % Vigorous**
< 34 years (*8*)	14.16%	44.76%	41.08%	0%
35-44 years (*36*)	17.48%	48.24%	34.18%	0.1%
45-54 years (*25*)	19.00%	48.22%	32.78%	0%
55-64 years (*22*)	18.69%	51.16%	30.15%	0%
> 64 years (*19*)	19.39%	52.45%	28.16%	0%

Discussion and Conclusions

Findings clearly show that regardless of position, curling participants achieved a moderate amount of physical activity during typical gameplay and that a majority of playing time was spent engaged in light or moderate levels. While most PA research tends to emphasize the important of time spent at the moderate and vigorous levels, there is emerging support for the promotion of activities that may only achieve light levels of PA. For example, Lamonte, et. al., (2017) reported that light PA contributes to better CVD risk factor levels in addition to, and independent of, MVPA. As expected, curling positions that include sweeping the rock and moderate to brisk walking (i.e., the lead and second positions) spent more time at the MVPA levels than the vice and skip positions which require less sweeping and walking. Also, given that the behavior expectations for each curling position are essentially the same for all participants, it was surprising to find that females had slightly higher levels of moderate activity than their male counterparts. This may be due to a difference in the amount of sweeping force exerted between male and female curlers. For example, males may have the ability to exert more sweeping force during each sweeping stroke than females and, therefore, may be able to achieve the same outcome with less activity than their female counterparts. However, males were much more likely to play in the vice and skip positions which require less sweeping and walking, and males were the only study participants to reach any level of vigorous activity. Clearly, this requires further research. Finally, and also as expected, older curling participants (e.g., >58) achieved the highest amounts of sedentary activities. Again, this was likely influenced by the curling position as older participants were more likely to play in the vice and skip positions.

Findings from our estimate of METs indicated that curling would be classified on the border of light and moderate physical activity (Ainsworth, et al., 2000). Examples of activities that have moderate (3.0 - 6.0) to low MET values (≤3.0) according to Ainsworth et al. (2000) include walking the dog, taking out the trash, mild stretching, fishing, hunting, slow ballroom dancing, and picking fruits and vegetables. Again, it is possible that this mean estimated MET value underestimates the true exercise value. Accelerometers register movement “counts”

which are then used to calculate an estimated MET value. This type of measurement would necessarily be affected by low activity periods with little movement. We also did not ask participants for their height and weight, and thus, we cannot adjust specific METs based on body composition. On the other hand, total step data indicated that participation in beginning curling could make a significant contribution toward meeting the 10,000 – 13,000 daily step recommendation (Saint-Maurice et. al., 2020). On average participants accomplished 2936 steps (~30%) within the curling sessions (duration of 81 min). Furthermore, the intermittent nature of curling does not influence total step count as a marker of activity or create the same difficulties in interpretation as mean values. Therefore, total steps may be an excellent means of examining physical activity outcomes in future studies involving curling. It is also important to note that the positive relationship between daily steps and health may start at lower daily steps for older adults according to Paluch et. al., (2022). The mobility limitations, lower biomechanical efficiencies, and lower aerobic capacity of older adults may restrict the number of steps older adults can accumulate in a day (Buddhadev, Smiley, and Martin, 2020; van der Vorst, Zijlstra, Witte, et al. 2016). Therefore, older adults could possibly achieve similar health improvements with few steps when compared to younger adults (Paluch, et. al., 2022).

With the rapid growth of people 65 and older in the United States driven by the aging baby boomer generation (US Census Bureau, 2023) there is an increasing demand for opportunities to engage in activities that are physically challenging but accessible and include an element of social connection. Although findings from our study showed that older participants had slightly lower levels of PA than younger participants, they still achieved a reasonable amount of activity. Even a minimal increase in physical activity can provide older adults with significant health and well-being benefits (Stenner, Buckley, and Mosewich, 2020). Also, since most curling matches last for almost two hours and most recreational curlers in the US play two or more times per week (Kanters, et. al., 2023), the sport of curling represents a significant opportunity for adults of all ages to achieve the recommended amounts of physical activity. Furthermore, there is a key component of social connectedness offered by team sports like curling that is critical for older adults (Sivaramakrishnan et al., 2024).

The findings that curlers reach moderate activity levels during about one-third of their playing time suggest that curling can be a valuable health activity for older adults. As healthcare costs associated with unhealthy aging have risen, there has been an increased focus on the benefits of sports for older adults, specifically re-engaging them in sports (Jenkin et al., 2017). Sports tailored to older adults can enhance health and serve as avenues for preventive medicine.

Team sports like curling, which are inherently social, also provide additional benefits by fostering social connections and support (Eime, Young, Harvey, Charity, & Payne, 2013). These social interactions through sport are crucial in preventing loneliness and social isolation (Sivaramakrishnan et al., 2024), which are top concerns for national health organizations such as the CDC. For example, in a recent systematic review on sports and older adults, Stenner et al. (2020) found that, aside from social benefits, the appeal of sports competition is often underestimated by providers. Age-appropriate sports, such as curling and pickleball, are effective health interventions because they incorporate various types of physical activity and offer social and psychological benefits, including competition (Casper, Bocarro, Lothary, 2021). Future studies need to validate the connection between curling and social connectedness. Conversely, as with any physical activity, certain risks are inherent with participation, particularly among an elderly population. For example, in a recent examination of 300 pickleball related injuries, 90 percent of patients were 50 years or older (Forrester, 2020). Forrester (2020) also reported an increasing trend of injuries, especially among an older population of participants. Future studies should examine the prevalence, nature, and severity of curling-related injuries to determine if a similar trend exists within curling, and if warranted, strategies employed to inform participants and mitigate injury risks.

Following the success of USA Curling at the Olympics in 2018 and a general perception that it was a sport that anyone could play, it seems evident that this perception has attracted a growing number of participants (Kanters, et. al., 2023). However, the aging US population is likely to include a large segment of people who want to participate in challenging activities. The sport of curling, like pickleball, seems to have characteristics that make it relatively easy to learn. However, like any sport, progressive development and improvement require the advancement of skills and physical demands. Given our findings that curling requires moderate levels of physical activity, strategies to promote the sport among an adult-aged population should consider highlighting that although the sport may be easy to learn, it does require a moderate amount of physical activity and could be considered a significant contributor to an active lifestyle. Moreover, curling may be a good sports participation option for adults looking for alternatives to meet recommended weekly amounts of MVPA. Participants should also consider playing in one of the first three positions to maximize the amount and intensity of PA achieved while playing. Curling also requires balance, coordination, muscular strength, multitasking, and strategic reasoning, which make it an ideal sport to promote for adults of all ages and sports abilities. Unfortunately, there still appears to be limited opportunities to participate in curling across the United States, especially in warmer climate regions of the country. Furthermore, when opportunities are available, membership fees and transportation costs are likely barriers to participation as evidenced by Kanters, et. al. (2023) finding that 95 percent of respondents to a national survey of curling participants in the United States indicating that they were white and almost 70 percent earned over $100,000 annually, suggesting that curling in the U.S. could be viewed as a sport for elite white participants. (Kanters, et. al., 2023).

Implications for Practice and Policy

Findings should be used to inform strategies for promoting curling as an opportunity for team sport involvement that has the added value of contributing to daily physical activity. However, access and opportunities to play, especially for underserved populations, are limited. Given that most curling clubs in America are private and require a membership to play (Kanters, et. al, 2023), partnership arrangements between existing clubs and public parks and recreation departments could increase both access and opportunities to play.

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