ANNEX 3

Task 2 - Task Characterization

1. Introduction

The first trampoline park appeared in 1959 and was outdoors. Numbers quickly grew in terms of visits and profits, but also in injuries that in following years led to decline and closure.

The indoor trampoline parks as we know them opened for the first time in 2004 in the USA and in Europe they appear ten years later.

Lack of regulation and increasing number of injuries, make it essential to understand the behaviour of users due to the different types of layout of trampoline parks. Thus, it is important to analyse the motor tasks[1] provided by trampoline parks and the possible behaviour pattern of users to understand if they are therefore exposed to risk.

2. Methodology

To get to know the different types of layout we did a search on Google, to identify the most referenced parks, focusing our attention on the trampoline parks with presence in several countries. Then we look for suppliers and through the catalogues confirm the different types of trampolines and finally identify the possible tasks.

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[1] Motor task - Unit of activity, in a given environment, developed as a response to a stimulus, requires more than one operation and has a defined objective. In an ecological perspective the aim of the task is related with the constraints of the performer and environment. The user's understanding of this relationship guides the skills choice to carry out the task.

With this information it was possible to build an observation sheet with the different possible tasks, having as reference the jumps performed in the trampoline gymnastics and the variations inherent to the play and leisure context.

With the first version of the observation sheet, we did an observation test in one of the trampoline parks in the Lisbon area. After this observation, we included the identification of the practice time and some behaviours that were not foreseen. From here we organized the new observation sheet according to the difficulty levels and made a version to observe a single user for an hour and another one to observe specific zones previously identified.

For the observation sheets, we identified seven levels of difficulty (0-6) associated with the possible behaviours on the trampolines in general. In level 0 we have the falls, in level 1 the different types of vertical jumps, in level 2 we have the different positions in vertical jumps, in level 3 we have the seated, front and back landings, in level 4 we have somersaults, in level 5 we have somersaults with twists and on level 6 we have the double somersaults. Considering that there are areas with different characteristics, depending on the type of trampolines or different dispositions of the equipment we identified 7 more category groups. We have a group of "others", where there are behaviours associated with the moments of pause inside and outside the trampolines, and then we have the groups with the specific behaviours of the areas such as the free jump, basketball, football, trampoline wall, dodgeball and tumbling.

Then the observation sheets were used to record the occurrences (number of times the behaviour was verified), the number of users and the time spent in a given spot.

We held two meetings to prepare 15 observers, all students of sports science and we were present in the first observations that each made. In average each observer has done 12,2 hours (maximum 15 hours) in three periods with a maximum of 5 hours. We have a total of 183 hours of observation.

The observations were made in three trampoline parks in the Lisbon district, two of them with more than 3000m^2 and one with 2000m^2. We wanted to do 100 hours of observation in each one, but for different reasons we only reached the hours shown in Table 1.

Table 1.
Observed Hours per park

T Parks	N	%
A	74	40,4
B	39	21,3
C	70	38,3
Total	183	100

Unfortunately, the observations were made in December and at the beginning of January, with a low turnout, which made the predicted data collection impossible. When we were preparing for a second collection in order to complete the missing data, the conditioning associated with Covid-19 occurred.

The observations were made by the type of use where only one user was observed over an hour (User) and by spots where the observation was of all users who were in that spot over the hour (Spot). We have planned 30 hours for each type of use and for each spot and the data collected is presented in the following tables.

For "free use", we reached the number of hours of observation planned, but for "with supervision use" (small group with one monitor who give instructions) and for "party use" (party group with one monitor who manages the activities) the number of observations was reduced (Table 2). In our analysis, to allow a comparison with free type of use, we have grouped the two types of supervised uses (party plus supervision) because they have similar characteristics.

Table 2.
Observed Hours per type of use

Type	Frequency	%
Free	31	73,8
With supervision	3	7,1
Party or groups	8	19
Total	42	100

For the different spots we had a number of observations closer than expected but with the lower values on the Trampoline Wall, Dodgeball and Football (Table 3).

Table 3.
Observed Hours per spot

Spot	Frequency	%
Basketball	20	14,2
Dodgeball	15	10,6
Football	10	7,1
High Performance	23	16,3
Wall	17	12,1
Free Jump	23	16,3
Tumbling tracks	33	23,4
Total	141	100

3. Results

As a starting point in the analysis of the results, it is important to reinforce that these data is from three Portuguese trampoline parks and that we believe they are different from country to country for cultural reasons.

The observed users had an average of 58,5 min of practice time, doing a 2,7 min warm-up, alternating their practice in 10 spots (which can be repeated) and staying there 6,8 min, with a maximum between 7 to 40 min (Table 4).

On average, in free use, there is almost no warm up (1,4 min), the number of spots covered is close to 11 with an average time of 5.6 min in each. The user participating in parties or with supervision on average has greater warm up (5,2 min), circulates less in the arena, uses fewer spots (7,7) and stays longer in them (9 min).

Knowing that participation in parties or with supervision has a greater orientation from the monitors, we can see that they influence the behaviour of users within the arena/court. This is an important point for future standards where the participation of the monitors will serve to maintain order but also to guide users' behaviours and may increase safety.

Table 4.
User behaviour in the arena/court

Type	Practice time	Warm up	Average number of spots	Average time on spot	Maximum time on spot
All	58,5 min	2,7 min	10,0	6,8 min	7-40 min
Free	58,9 min	1,4 min	10,9	5,6 min	
Party/supervision	57,5 min	5,2 min	7,7	9,0 min	

Users in general pass through the spots repeatedly over the course of an hour but Football is the least used with a value of 0,5 times which indicates that many users do not jump on this spot. Tumbling is the most frequented spot (2,4) where they spend more time, with an average of 14,6 min, followed by Free Jump (1,8) with an average of 13,7 min.

Free users change spots more often using all of them except Football. Tumbling is the most frequented spot (2,7) with an average of 13,2 min, followed by Free Jump (1,8) where they spend more time with an average of 14,5 min.

When users are at party/supervision, Basketball is the least used spot (0,3) as well as Football and High Performance, both 0,5 times. This usage being conditioned by the monitors, apparently many choose not to go to these spots. Free Jump and Tumbling are the most frequented and in this last one they spend more time, with an average of 18 min (Table 5).

Table 5.
User behaviour per spot

Type of use	Other spots		Free Jump		Basketball		Football		T Wall		H Performance		Dodgeball		Tumbling	
	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T
All	1,5	6,6	1,8	13,7	0,8	3,9	0,5	3,0	1,1	4,9	0,9	5,6	1,1	3,6	2,4	14,6
Free	1,4	5,9	1,8	14,5	0,9	5,2	0,5	3,6	1,2	4,9	1,1	5,8	1,3	4,1	2,7	13,2
Party/supervision	1,7	8,5	1,7	11,7	0,3	0,5	0,5	1,5	0,8	4,7	0,5	5,2	0,7	2,3	1,7	18,0

The greatest number of occurrences (423) are in Difficulty 1 which corresponds to the vertical jumps. Then we have Difficulty 2 (vertical jumps variations) and 3 (different landings) with values close to Difficulty 0 (falls). It is evident the reduced number of occurrences with Difficulty 5 (somersaults with twists) and with Difficulty 6 (double somersaults).

The greatest number of Difficulty 1 occurrences is on Free Jump. Difficulty 3 is divided by Free Jump, Trampoline Wall and High Performance. Difficulty 4 is characteristic of Tumbling

because it ends in the foam pit or airbag, which also justifies the occurrence of Difficulty 5 and 6. The occurrence of Difficulty 6 in Free Jump does not seem appropriate and is to be avoided (Table 6).

Table 6.
User difficulty frequency in each spot

	OS	FJ	B	F	TW	HP	Dod	Tu	Total
Difficulty 0	6	28	4	2	11	15	13	14	93
Difficulty 1	48	115	29	18	36	39	74	64	423
Difficulty 2	14	24	1	0	15	20	8	15	97
Difficulty 3	11	25	2	0	24	28	6	7	103
Difficulty 4	3	7	0	1	2	6	1	24	44
Difficulty 5	1	1	0	0	0	0	0	3	5
Difficulty 6	1	1	0	0	0	0	0	1	3

The most common falls are on the knees and on the side but unfortunately there are 5 head falls.

Most Difficulty 1 occurrences are "two feet jumps" (simultaneous) but there are many jumps that increase the risk of injury as they are only made with one foot and to other trampolines.

The number of occurrences for Difficulty 2 jumps (vertical jumps: tuck, straddle and twist) is 97 but they should be higher when compared to the risk behaviours of Difficulty 1 (i.e. alternate foot jump, jumps to other trampoline, one foot jump) that should be smaller.

Difficulty 3 has higher values for seated landing (seat drop), which is normal because it is the easiest movement to perform and with the least fear or vertigo. The value of frontal landing (front drop) is very high due to the risk of low back and arms injury and should be avoided.

Difficulty 5 and 6 have few occurrences, which is good but may be due to cultural differences and a relation with the lack of experience of Portuguese users.

Table 7.

Number of skills per degree of difficulty

	Dificulty	N
0	knees falls	42
	head falls	5
	side falls	42
	two users falls in same trampoline	4
1	alternate foot jump	58
	alternate foot jump to other trampoline	47
	two feet jump	160
	two feet jump to other trampoline	61
	one foot jump	16
	one foot jump to other trampoline	16
	running	65
2	tuck jump	37
	straddle jump	30
	twist jump	30
3	seat drop	56
	back drop	32
	front drop	15
4	front somersault	29
	back somersault	15
5	somersaults with twists	5
6	double somersaults	3

In Table 8 the "stand out of trampoline" is the only safe behaviour and represents almost 50% of the other behaviours. "Stand on trampoline" or "two users on same trampoline" are unsafe behaviours that altogether represent a little bit more than 50%.

It is in the Free jump spot we can see more users stand on trampoline. This may happen because there must be a trampoline per user and after a few jumps a break is needed to rest. But with good supervision this should not be the case because it is dangerous to remain on the trampoline.

There are two categories of behaviour with two users simultaneously on the same trampoline and together they have 46 occurrences. It is in the Free jump, High performance and Dodgeball spots where the most occurrences were registered. The number is not very high but considering that it is one of the most important rules for the safety of users, it is not clear why it still occurs.

Table 8.
Number of other behaviours

Other behaviours	OS	FJ	B	F	TW	HP	Dod	Tu	Total
stand out of trampoline: laydown, seatdown and upright	12	21	3	2	9	16	9	20	92
stand on trampoline without jump: laydown, seatdown and upright	3	19	3	2	11	8	10	6	62
Two users jumping on same trampoline	4	6	2	1	1	4	5	3	26
Two users on same trampoline: one jump other stand	1	6	1	0	0	5	6	1	20

In the analysis of user behaviours in the spots, we collected data on the number of users for periods of five minutes, which allowed us to understand the dynamics over an hour and the maximum number of users simultaneously.

The behaviours analysed are grouped into categories of difficulty and specific movements of the spots if they exist.

In the Free jump spot the number of users most of the time exceeds 15 except in park B where that is the maximum value.

In park A we have a maximum of 46 users and in every park, it is in the last 15 minutes that the number tends to decrease.

Table 9.
Free jump maximum number of users for 60 min period

time Free Jump users max	0	5	10	15	20	25	30	35	40	45	50	55	60
Park A	19	36	37	36	37	26	34	31	46	35	32	31	22
Park B	8	13	10	10	10	11	11	10	12	15	11	10	12
Park C	18	15	15	16	15	20	19	14	11	7	9	10	5

40% of the movements are of Difficulty 1 (vertical jumps) but 20% are falls (Difficulty 0) which shows the lack of experience of the users. The remaining movements are Difficulty 2 (14% different vertical jumping positions) and Difficulty 3 (16% landings). In Difficulty 4 there are somersaults (8%), in Difficulty 5 (somersaults with twists) the number is reduced (2%) and there are no double somersaults (Difficulty 6).

Figure 1.
Free Jump users' behaviours
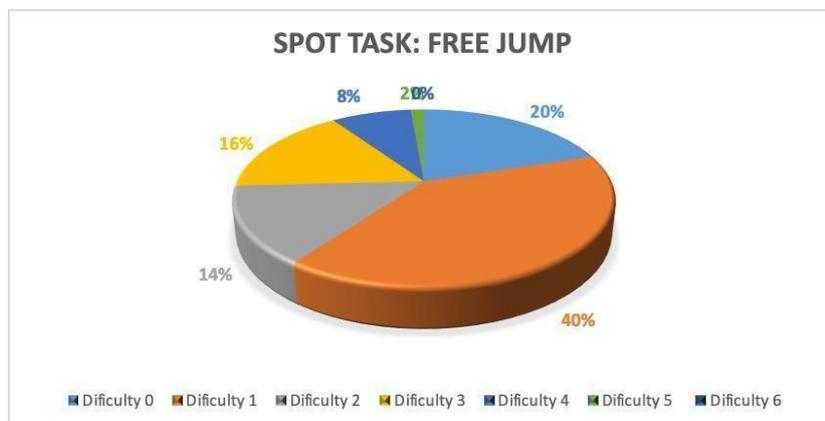
In the Basketball spot the number of users is reduced over the period of 60 minutes. This is an example where one monitor / supervisor will suffice.

Table 10.
Basketball maximum number of users for 60 min period

time Basketball users max	0	5	10	15	20	25	30	35	40	45	50	55	60
Park A	3	2	5	6	4	5	8	8	6	5	6	3	3
Park B	3	5	4	3	4	3	4	3	3	4	4	3	4
Park C	0	1	2	3	4	5	6	7	8	9	10	11	12

As expected, the predominant behaviour is specific to basketball (41%) followed by vertical jumps (Difficulty 1). There are also behaviours of Difficulty 3 (landings) and 4 (somersaults) that are unsuitable for this spot for safety reasons.

9

Figure 2.
Basketball users' behaviours
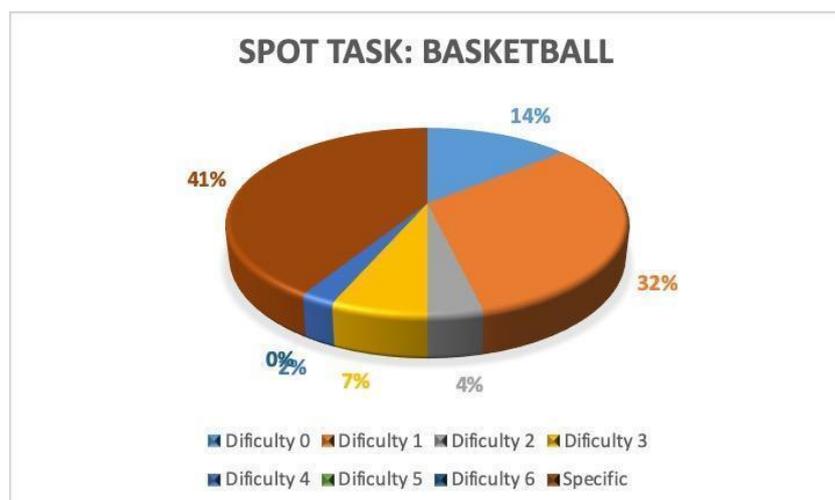
The specific movements on Basketball are different types of throws but there are concerns about the trajectory of the ball thrown by another user or after bouncing on the backboard.

Table 11.
Basketball specific actions

	Basketball
Basket throwing	22,73%
Jumping to reach the basket	22,73%
One jump to reach the basket	12,50%
Slam dunk	14,77%
Avoid ball trajectory	4,55%
Air throwing	22,73%

In the Football spot over the 60 minutes there is also a reduced number of users except in park A where close to 30 minutes where there were more than 15 users. In park B there is a slight increase in the last 10 minutes.

Table 12.

Football maximum number of users for 60 min period

time Football users max	0	5	10	15	20	25	30	35	40	45	50	55	60
Park A	2	4	8	6	4	18	15	4	6	8	4	7	2
Park B	0	1	2	3	4	5	6	7	8	9	10	11	12
Park C	4	6	7	6	6	5	5	5	3	3	3	5	7

The behaviour of the users is very similar to the basketball spot with the occurrences of landings (Difficulty 3) and somersaults (Difficulty 4) which are inappropriate for safety reasons. These behaviours can occur due to the users' lack of knowledge or due to the lack of guidance from the monitors / staff.

Figure 3.

Football users' behaviours
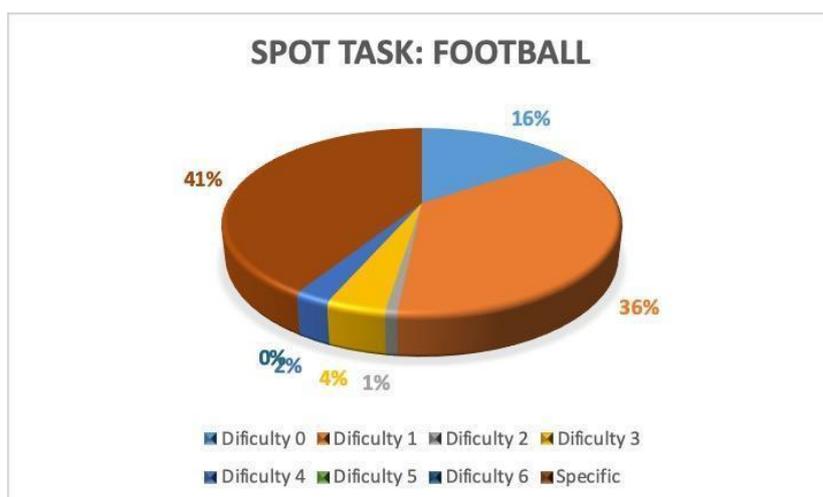
Running was one of the behaviours previously identified during the construction of the observation sheets and should not occur often but appears with a percentage of 20.5%. The specific action for transporting the ball (jumping with the ball between the legs) to make the shots also previously identified has no occurrences. This situation shows the lack of knowledge of users and little intervention by monitors / staff to guide the practice.

Table 13.
Football specific actions

	Football
Ball kicking	22,7%
Ball defence	22,7%
Head kicking	4,5%
Bicycle kick	18,2%
Running	20,5%
Playing 1X1	11,4%
Jump with ball between legs	0,0%

The Trampoline Wall spot has two moments in park A with a slightly larger number, but with a reduced frequency of users. Here we can have a social justification for the lack of participation by Portuguese users but the strongest reason could be the difficulty of the movements for a more fun practice. In other words, the effort is great at an early stage of learning and therefore it is not a very appealing spot.

Table 14.
Trampoline Wall maximum number of users for 60 min period

time T Wall users max	0	5	10	15	20	25	30	35	40	45	50	55	60
Park A	16	3	5	6	6	6	6	6	12	6	7	8	4
Park B	4	4	7	5	4	5	6	5	4	5	5	4	3
Park C	1	2	3	3	2	2	2	3	1	1	1	1	0

A confirmation of the difficulty in executing the specific movements of this spot is the percentage of only 17% and the highest value (28%) for vertical jumps (Difficulty 1). Part of the specific movements depends on the landings (Difficulty 3) which justifies the occurrence of 17%.

Figure 4*.*
Trampoline wall users' behaviours
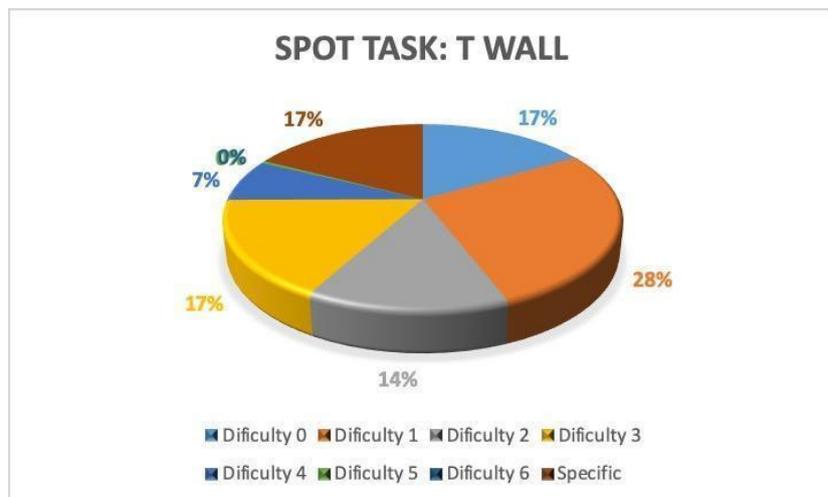
The specific actions are equally divided except for the category walking to reach the top due to the greater technical and physical demands of this movement.

Table 15.
Trampoline Wall specific actions

	T Wall
One-foot touch on wall	32,50%
Two feet touch on wall	30,00%
Walking on wall	25,00%
Walking reaching the top	12,50%

In High Performance Trampolines - Park A has a use closer to our expectations but sometimes there are an excessive number of users (45' and 55'). This is a spot with several trampolines but the ideal would be a maximum of 5 users per trampoline. Thus, the 40 users are an

excessive number, with many people in the surrounding areas, which reduces safety if there is an uncontrolled jump off the trampoline. The values in Park C are smaller but noticeable because there is only one high performance trampoline.

Table 16.
High performance trampoline maximum number of users for 60 min period

time H Perf. users max	0	5	10	15	20	25	30	35	40	45	50	55	60
Park A	16	13	16	17	28	23	26	15	14	40	31	36	18
Park B	4	4	4	4	3	3	3	5	5	3	4	3	4
Park C	1	2	3	3	2	2	2	3	1	1	1	1	0

For this spot the percentage of Difficulty 1 jumps is excessive (preparatory or uncontrolled jumps), with an increase in Difficulty 2 and 3. Here it is expected that the percentage of somersaults (Difficulty 4), somersaults with twists (Difficulty 5) and double somersaults (Difficulty 6) increase. This does not happen for Difficulty 6 with 0 records, which shows the weakest level of users because these jumps are allowed. With the slight increase in difficulty, the number of falls also increases slightly (Difficulty 0) 19%.

Figure 5.
High performance trampoline users' behaviours
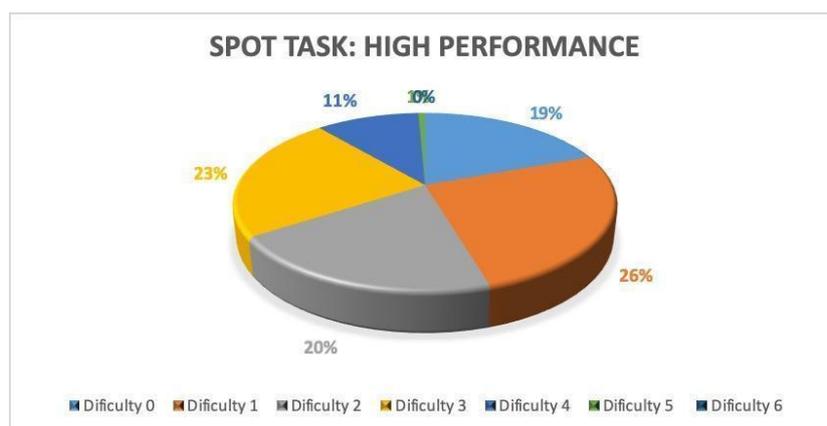
The Dodgeball arena can have 18 trampolines (9 for each side) and teams must have 5 players and can have a maximum of 9. Considering that there is an increased risk of injuries for

handling the balls and the goal of hitting opponents the number of users should not exceed one per trampoline.

It is evident that in park A the number of users is excessive over the 60 minutes, jeopardizing the activity and safety of users. In the other parks the number, although sometimes reduced, it is close to capacity of this spot.

Table 17.
Dodgeball maximum number of users for 60 min period

time Dogeball users max	0	5	10	15	20	25	30	35	40	45	50	55	60
Park A	4	25	28	26	26	27	23	21	12	11	23	22	19
Park B	5	5	7	8	9	11	8	10	10	10	11	14	12
Park C	0	1	2	3	4	5	6	7	8	9	10	11	12

With the Difficulty 1 and 2 values representing 50% of the behaviours, it seems that this spot is being used as the free jump spot although 21% are specific actions using the ball. Relating the specific actions to the number of users, safety conditions should be reconsidered.

Figure 6.
Dodgeball users' behaviours
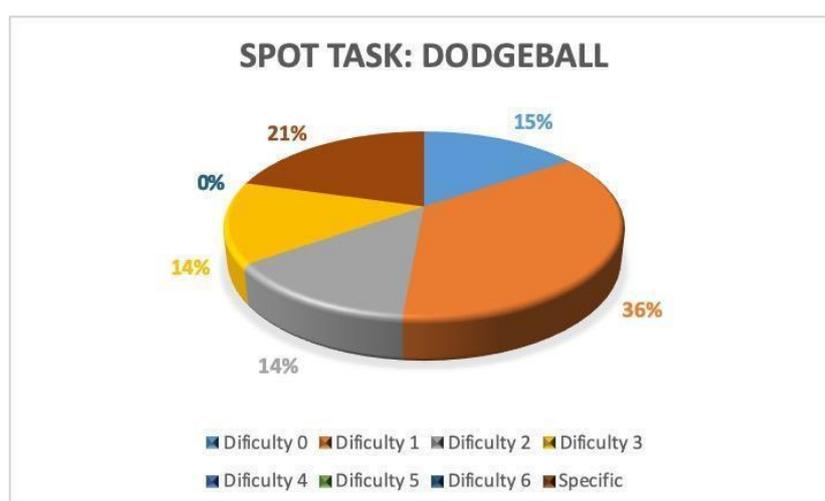
The specific actions registered confirm the practice next to the game expected to take place on this spot, but it should be with a referee (monitor / staff).

Table 18.
Dodgeball specific actions

	Dodgeball
Avoid ball trajectory	41,67%
One hand throwing	41,67%
Two hands throwing	16,67%

Tumbling tracks are an appealing spot because they allow a linear displacement and often end in the foam pit or airbag. The feeling of vertigo increases compared to the other spots not only due to the speed of travel but also due to the greater ease in linking different movements.

Being a dynamic spot, it is possible to have a higher number of users, but their presence on the bed at the same time has an increased risk. As at the end of the track you must always have a free zone for a safe landing.

Another risky action is the use of the track without a defined direction, that is, it must have an entrance zone and an exit zone. Without guaranteeing these rules, a high number of users is synonymous with a lack of safety.

Thus, the number of users will be related to the number of tracks included in the spot, and 5 or 6 users can be considered for each waiting for their turn in the starting zone while one uses the track. Park A has one moment with an excessive number of users (25' with 32 users).

Table 19.

Tumbling tracks maximum number of users for 60 min period

time Tumbling users max	0	5	10	15	20	25	30	35	40	45	50	55	60
Park A	16	16	20	20	24	32	23	19	15	18	15	21	10
Park B	5	12	8	6	5	6	5	5	5	7	20	13	5
Park C	3	3	5	4	6	5	5	2	4	4	4	6	4

In this spot, the linear displacement should be a reference so it does not make sense to have 11% of landings (Difficulty 3) because they are movements to be carried out vertically and with an impulse at the same point. This behaviour is due to the lack of knowledge of the users and possibly lack of instructions from the monitors / staff. The percentage of specific movements should be higher, but in part this is justified by the users' lack of knowledge or capacity.

Figure 7.
Tumbling users' behaviours
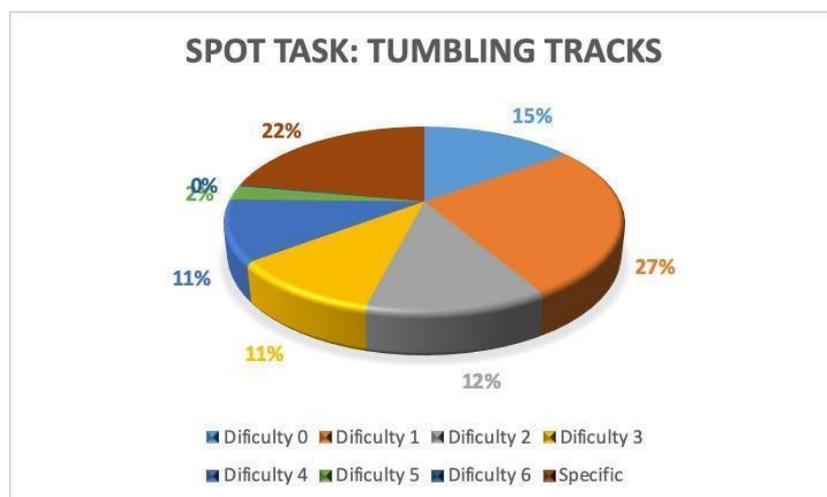
Linear displacement is characteristic of this spot and the bed format itself gives that guidance to user and it justifies the 20% of walking until the end of the track.

With an identical percentage appear front and back rolls that are not suitable for this spot and that in some cases can be risky for the neck and arms.

The percentage of cartwheels and roundoffs makes sense but should be associated in link with other movements. But the lack of capacity of users justifies the low percentage of links.

Table 20.
Tumbling specific actions

	Tumbling Tracks
Walking until the end of track	20,45%
Front/back roll	19,32%
Cartwheel/roundoff	21,59%
Front handspring	10,23%
Back handspring	12,50%
Front/back spider	3,41%
Tempo	2,27%
Link 2, 3 or 4 elements	10,23%

4. Conclusions

This observation has the limitation of being carried out only in Portugal, and these data cannot be used for a broader analysis at European level. It serves to prove the existence of some behaviours, their relationship with the different spots and the need for effective supervision by the monitors / staff.

We identified 3 types of use, one free and the other two supervised (party and supervision) by monitors / staff.

Time management and passing through the different spots is different for free use or for supervised use. Thus, we can conclude that the presence of the monitors influences the users' behaviour within the arena/court.

The lack of knowledge and capacity of the users was evidenced in the analysis of the behaviours in each spot. This conclusion is supported by the repetition of behaviours even in spots with different characteristics with added danger because some of them are inappropriate.

The number of users in each spot and some of the observed behaviours are associated with the management / supervision carried out by the monitors / staff. The lack of supervision or possible lack of compliance by users increases the risk and should be considered in a change of rules or procedures.

In order to guarantee the safety of users and to allow the simultaneous presence of different technical levels, a technical program should be considered to clarify and identify the opportunities and potential risks of each spot. This same program should allow a progressive passage through the different levels of difficulty and create a technical level identification (handicap - as practiced in golf) for the user to know what he could do in each spot.