Original article

Title: Does modifying competition affect the frequency of technical skills in junior rugby league?

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Abstract

The technical demands of games can be affected by changing the number of players, pitch size and rules. This controlled trial compared the frequency of technical skills between a 'traditional' and newly introduced systematically 'modified' game of primary rugby league. A total of 475 primary rugby league players (Under 7s - 9s) were filmed playing traditional (n=49) and modified (n= 249) formats. Notational analysis examined the frequency of technical skills (e.g., number of passes) within 'traditional' and 'modified' games. At each age category, multivariate analysis of variance indicated the clear superiority of the 'modified' game for the frequency of technical skills (e.g., Under 7s total skill opportunities - 'traditional' = 342.9±47.0; 'modified' = 449.4±93.3, d=1.44, p<0.001). Systematically modifying the competitive game is an effective way to increase skill opportunities for children within rugby league. Future research should examine the outcomes of modifying games in optimizing skill development in youth sport.

Keywords

Introduction

Importance of skill opportunities for children playing sport

Positive, early, sport experiences for children are considered vital to sustaining participation and fostering a lifelong love of sport and physical activity [1]. Furthermore, it is suggested that a 'Lifespan' perspective of movement development begins with an early and crucial phase of developing technical skills that forms the foundation of subsequent participation in sport [2]. There is evidence to suggest that learning and improving sport skills are the most prominent reasons why children participate [3], while sports participation is enjoyed more when children feel competent in performing sport-specific skills [4]. Even though evidence suggests that modified games in practice situations provide a platform to ensure children develop and possess the prerequisite skills to flourish in sport [5, 6], less is known about the contribution that competitive games can make in developing these skills.

The nature of competition in youth sports

Organised competition demands concentration and effort, provides children with an opportunity to develop tactical awareness and is highly rated by elite athletes for developing skill execution and physical fitness [7]. 'Sampling' a range of sports has been recommended in order to facilitate the transfer of technical skills that then become more portable, less defined by the sport and more useful for the developing child [8]. Recommendations have also been made to reduce the amount of competition in early sport experiences in order to avoid 'burnout' caused by anxiety and burden related to participation in competition [9,10]. While the literature focuses predominantly on children's participation in competition and more specifically offers guidance for elite or talented junior athletes [11, 12], there is very little empirical research on whether traditional, non-modified, competition is meeting the varying needs of younger

participants or the sport. Indeed, it is questionable how well simply scaling down adult competitive games serves the technical developmental needs of children [9].

Modifying games

Systematically modifying games to emphasise players' use of key developmental skills is not new; physiological, technical and tactical demands have been extensively examined across a range of sports such as soccer, basketball and rugby league [6, 13, 14, 15], although the majority of studies concentrate on elite populations. A recent review suggested that studies measuring the effect of modified games on the technical demands of sports are relatively scarce and existing work is dominated by assessing the impact of small-sided games on young adults at recreational and elite level, using relatively small sample sizes, with limited duration and within a practice-type game situation [16].

In studies of modified games, Burton and colleagues [17, 18] modified youth flag football for children aged 8-9 years. Using a smaller ball and implementing a 3-second rule whereby players could not attack for 2 seconds after receiving a pass, scoring increased from 745 points during the season to 1158 points in the modified game. Furthermore, almost twice as many players scored a goal (47%), as in the previous season (27%). These results are important since participants typically regard offensive skills as offering most fun within sport; the likelihood is that increased intrinsic motivation results [19].

While the majority of empirical studies that explore the impact of modifying competitive games come from the USA, game modifications are also commonly employed by National Governing Bodies of sport in the British Isles [20, 21, 22, 23]. Although there is little empirical evidence of the effectiveness of these modified games with young children, examples from rugby and soccer are the exceptions. Thomas [24] used notational analysis and found that the modified game (with reduced space, ball size and number of players) resulted in 55% more

runs with the ball, more than twice as many successful passes and scoring nearly twice as many tries. In soccer, a study comparing a 4v4 and 8v8 game played within Premier League Academies (players' m age=7 years) showed that the total number of ball contacts was 2.8 times greater in the 4v4 than the 8v8 game [25].

Context, aim and hypothesis

In 2012, the National Governing Body for Rugby League in England - the Rugby Football League (RFL) - instigated a review of rugby league for players aged 5-11 years. The review was prompted by growing concerns about the lack of children's meaningful experiences during match-play, decreasing retention rates, and a sense that the game favored the more physically developed child [26, 27]. In response, the authors were commissioned to research the impact of a newly introduced 'modified' game in comparison to the 'traditional' primary rugby league game being played at the time [28].

To redress the shortfalls in existing evidence, this study aimed to compare a modified game with a traditional game in a competitive setting, featuring a large sample of players, over a sustained playing period. Moreover, the new modified game explicitly aimed to offer more skill development opportunities, which provided a meaningful and measurable outcome [29]. This study is highly relevant as it has the potential to enhance understanding of how to systematically optimize playing environments so children develop their skills during initial experiences of sport. The hypothesis was that a modified game would increase the frequency of players demonstrating technical skills in comparison to the traditional primary rugby league game.

Methods

Introduction

A technical group was established comprising RFL staff with expertise in coaching children. This group designed the modifications for the modified game, as demonstrated in Table 1, which consisted of changes to the size of the pitch, the use of a 'touch' or 'full' tackle, playing time and rules. To ascertain the impact of the modified game in comparison to the traditional primary rugby league game 17 key variables were identified by the technical group as being critical to junior players' skill development within rugby league. Given that the appropriate age for safely introducing the full tackle to primary rugby league players is contested [28], the Under 8s game contained 'full' and 'touch' variants of the tackle to offer a comparative assessment of skill opportunities in both.

Insert Table 1 here

The 'traditional' primary rugby league game is a modified version of the adult 13-a-side game, with teams playing competitive home and away fixtures. Compared to the adult game, traditional primary rugby league requires nine players on each side, playing 15 minutes per half using a modified pitch of minimum size 50m x 30m, to a maximum of 60m x 40m. Game rules are as for full international matches with the exception of no scrums, no kicking in play or at goal, no running from dummy half, and a reduced defensive retreat, from 10m to 5m. Informed consent and assent, and local ethics committee approval, was provided before the commencement of the research.

Participants

Comparisons of traditional and modified games were achieved by observing 475 children, aged 6-9 years, within three different age groups (Under 7s (n=108), Under 8s (n=223) and Under 9s (n=144)), from 12 Community Rugby League clubs over 10-weeks of competitive play. Within the 10 weeks, traditional (n=49, yielding 1496 minutes of footage) and modified (n= 249, yielding 1360 minutes of footage) games were filmed producing a total of 49 hours and

20 minutes of play. Participants were filmed playing the traditional game in their existing fixtures schedule, whether competing at their home or away venue and the modified game midweek, at a location central to the participating clubs, based on each team competing against every other team.

Notational analysis

Notational analysis of technical skills [30], as shown in Table 1, was used to capture any differences between the traditional and modified versions of rugby league. Based on the technical group's advice, four key areas were identified to explore how well the modified game influenced opportunities for:

1. Specific skill development; passes, catches, kicks, tackles and 'around the world' runs
2. Offensive action; crossing the advantage/defensive line, line breaks and tries scored
3. Replicating patterns of play found in the full game; total plays, completed sets
4. Overall frequency of skill development; total skill opportunities.

All of the technical skills notated were typical skills found within Rugby League apart from 'around the world runs'. The research team created this term to describe the pattern of a player running with the ball perpendicular to the opposition before running straight in an attempt to penetrate the defence. Fieldworkers used these areas to annotate game footage and were blind to the purpose of the study so as to avoid coding bias. The accuracy of their notation was established by comparing outcomes from coders simultaneously watching and coding a 5-minute game of primary rugby league. This training process was repeated until an analysis of the inter-observer reliability produced an interclass correlation coefficient of 1.00 (n = 27; 95% CI = 0.99–0.1.00), indicating excellent agreement between the responder's observations.

Data analysis

Data generated by the notational process was analysed using the Statistical Package for the Social Sciences (SPSS Inc., Chicago, Illinois, USA). To make comparisons under consistent conditions, the means for all variables were scaled to a 30-minute period to control for time. To reduce bias, outliers identified by the maximum normed residual test were removed (p = 0.05).

Initially, a series of one-way multivariate analysis of variance (MANOVA) tests explored the differences between traditional and modified games at each age category (i.e., Under 7s, 8s and 9s). Preliminary assumption testing confirmed no serious violations of checks for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity. Effect sizes using partial eta squared (η^2) were used for the MANOVA with further Cohen's d effect sizes considered for individual variables.

To align our reporting of effect sizes with other educational literature, effect sizes were reported as negative *d* values if a reverse effect was observed [31]. Using a modification to the effect size scale of Cohen [32], z-scores were assessed against this profile; 0 to 0.2 was considered to be a trivial effect, 0.2 to 0.6 small, 0.6 to 1.2 moderate, 1.2 to 2.0 large, and a z-score of >2.0 represented a very large effect [33].

Results

Across every age group, there were statistically significant advantages resulting from the 'modified' over the 'traditional' game structure. The initial results from the one-way between-groups MANOVA revealed that there was an overall significant ($F_{17, 60} = 19.96$, $p < 0.001$; Wilks' Lambda = 0.15; $\eta^2 = 0.85$) difference in the Under 7s age category, Under 8s ($F_{17, 58} = 5.91$, $p < 0.001$; Wilks' Lambda = 0.36; $\eta^2 = 0.63$) and Under 9s ($F_{17, 43} = 5.86$, $p < 0.001$; Wilks' Lambda = 0.30 $\eta^2 = 0.69$) between the traditional vs. modified conditions.

A detailed breakdown of the dependent variables across the age categories is shown in Table 2. The table shows that for Under 7s the modified game had a large or very large positive effect on the total number of (i) plays, (ii) skill opportunities, (iii) passes and catches, (iv) around the world runs, (v) times a team crossed the advantage line and the defensive line and (vi) completed sets of tackles and (vii) the percentage of effective tackles. The table also reveals that the percentage of effective passes and catches did not reduce despite an increase in the number of skill events performed in the game. Similar results, although less strong, were seen with the Under 8s modified game. However, a small and moderate negative effect was seen in the percentage of effective passes and catches respectively. Likewise, in the Under 9s game the modified rules also had a positive moderate effect on the total number of (i) plays, (ii) skill opportunities, (iii) completed tackles, (iv) around the world runs, (v) line breaks, (vi) completed sets and (vii) tries scored. The number of times the ball was knocked on in the modified game also decreased significantly.

Insert Table 2 here

In the three different Under 8 rules that were trialed separately to investigate the influence of different tackling regimes (traditional, modified tackle and modified touch) there was a statistically significant difference between the rules on the combined dependent variables, ($F_{34, 262} = 7.58$, $p < 0.001$; Wilks' Lambda = 0.25; $\eta^2 = 0.50$). A detailed breakdown of the dependent variables and how they vary across three different rules types in the Under 8s can be seen in Table 3. The table reveals (i) more technical skills in the modified tackle rules and (ii) even more in the modified touch rules, although (iii) there was a moderate decrease in the effectiveness of the skills performed (passes, catches and tackles).

Insert Table 3 here

Discussion

This study offers a rare comparative examination of the differences in the frequency of technical skills within a traditional and modified game setting in competitive junior rugby league. Powerful and almost universal differences favored the modified game, which was designed to increase the number of opportunities to execute different skills when compared with the traditional game. These findings reflect the majority of previous studies that demonstrated an increase in the number of technical skills when modifications were made in similar sports and with a similar age range of participants [18, 24, 25].

Overall, the modified game clearly impacted in a range of key areas related to the study aims. Effects were strongest with Under 7 and Under 8 players, particularly for the total number of technical skills performed. More specifically, the modified game featured more passes, catches, plays and effective tackles, with players crossing the advantage and defensive lines and scoring more frequently than in the traditional game. These increases in offensive action are of particular significance when considering previous evidence suggesting that children enjoy this element of the game and that enjoyment is one of the main reasons cited for children's participation in sport [3, 19]. Given that previous research has established a positive relationship between movement competence and subsequent participation in physical activity and sport [5, 34], the sweep of these results suggests that, by offering more opportunities for technical skills to be developed, the systematically modified game is likely to retain more players in the game and prepare them for future experiences in sport, more effectively than the traditional game format.

Moreover, individual age-group differences merit further discussion. In Under 7s, the modified game produced fewer knock-ons - even with more pass receives. This may result from players feeling less pressurized than in the traditional game, where knocking-on a received pass results in surrendering possession to the opposition. The modified game also

produced substantially more 'around the world runs' and more examples of crossing both defensive lines than the traditional game; this is an interesting finding. Given that penetrating the defence is a core tactical construct of any invasion game, players playing the traditional game may use the most direct route to achieve this by employing a straight line of running. It is possible that 'around the world runs' allow young players the space and time to make a decision about the best way to penetrate the defence. Further research is needed to establish immediate and long-term issues around any such decision-making.

At Under 8s, in the 'full tackle' version, over the 'touch' version, fewer overall technical skills were performed. It is likely that the 'touch' takes less time to perform than the full tackle, creating more time to perform other technical skills. Certainly, the 'touch' game showed more plays, passes, receives, examples of crossing the advantage line and completed sets than the 'full tackle' matches. There were also significantly more kicks in 'touch' compared to 'full tackle' and more tackles in 'full tackle' matches. This may be linked to the increase in running time found in 'touch', which is likely to decrease opportunities for being 'touch' tackled.

Having more line breaks in Under 8s 'full tackle' may be explained by the comparative ease of making a 'touch', resulting in fewer line breaks. More tries were scored in the 'full tackle'; completing a full tackle may cause at least two players to fall to the ground giving them less chance to retreat to make a further contribution to defending. With more players on the ground at the full tackle, attackers will have more space, meaning that more tries are likely. In general terms, these results suggest that skills are being practiced to similar levels, regardless of tackle conditions. Thus, the 'full tackle' can be employed at Under 8s without detrimental effect on these skill opportunities, although other physiological and maturational considerations would still require consideration so as to protect the players from excessive contact that could lead to injury.

Under 9 games illustrated fewest differences between game conditions. This impact may link to the limited number of changes made to their 'traditional' game, compared to the many that the modified game represented for younger age groups. Even though there were fewer differences between game conditions in the Under 9 game, compared to the Under 7s and Under 8s, there were still more counts of technical skills in the modified game than in traditional play. For Under 9s, the modified game brought more tries, more tackles and 'around the world runs' than in the traditional game. Interestingly, the number of 'knock-ons' was twice that of the traditional game, again suggesting the possibility that players feel more pressure when a mistake loses possession. What could be inferred from the lack of differences between the two variants of the Under 9 game is that where modifications are minimal, the resultant impact on the game is equally minimal.

This study is not without its limitations. The research design did not identify the specific modifications that generated specific changes in skill events. For example, was it the reduction in space or players that lead to more passes? This is particularly important in light of previous research findings suggesting specific modifications create specific outcomes. For example, reducing the size of the playing field, whilst affecting physiological responses, had minimal influence on the volume or quality of skill executions, albeit with junior and senior elite rugby league players [15]. A constraints-led approach, which looks to identify how various constraints can affect competitive experiences, may prove fruitful for identifying the impact of specific playing modifications [35]. The different sample sizes and length of interventions across the three age groups may have also affected the results, although the reality of the fieldwork environment suggests that these anomalies will be typically encountered in the majority of natural settings.

Conclusions

By demonstrating the positive effects of modified games in increasing the frequency of technical skills in competitive events, this study supports existing research [18, 24]. Importantly, the current study provides comparative data in actual competitive settings, which is an important improvement in terms of existing research design. Furthermore, the inclusion of an expert group from the RFL within the research design proved a valuable resource in enhancing the meaningfulness and validity of the research. The scale and magnitude of the increases in technical skills that resulted from deploying the modified variant of junior rugby league is likely to produce players better equipped to transition into adult sport; whether at the recreational or performance level. Clearly, the modified game enhanced athlete engagement by generating more offensive technical skills, than was found in the traditional game. All National Governing Bodies of sport and coaches should review their current junior versions of their sport and consider introducing and evaluating modified games to ensure players are exposed to optimal technical skill development opportunities. Further research is needed to determine which aspects of a modified game produce which specific direct outcomes for participants.

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1   **Table 1.** Under-7s, under-8s and under-9s (all use size 3 ball)

Age Group	Numbers	Pitch	Touch/ Tackle	Time	Rules
Traditional primary rugby league (Under 7s, 8s and 9s)	9v9	Max. 60m x 40m Min. 50m x 30m	Tackle	Single games: 2 x 15 mins Festival games: 2 x 7 mins with 2 minute interval* *No player to play more than 40 mins in any one day	• Play the ball • Six tackles (regardless of errors at youngest age band) • No kicking • Defending players retreat 5m on tackle • One coach allowed on the pitch to 'aid players'
Under 7s	4v4	20m x 12m	Touch	Eight 5 minute games	• Touch and pass (no play the ball) • Six 'touches', regardless of errors • Option to kick on 5th tackle (grubber only) • Defending players must attempt to get onside by 2m • No coaches on the pitch
Under 8s	5v5	20m x 15m	Touch and Tackle (trialled separately)	Eight 5 minute games	• Touch and pass (no play the ball) • Six tackles, or touches, regardless of errors • Option to kick on 5th tackle (grubber only) • Defending players must attempt to get onside by 2m • No coaches on the pitch
Under 9s	6v6	25m x 18m	Tackle	Eight six minute games	• Play the ball • Six tackles regardless of errors • Option to kick on 5th tackle (grubber only) • Defending players must attempt to get onside by 4m • First receiver and dummy-half to wear bibs • One passive marker • No coaches on the pitch

2

Table 2. Comparison between Traditional and Modified Games at the Under 7s, 8s and 9s age categories

Category	Under 7s			Under 8s			Under 9s		
	Traditional (n=22)	Modified (n=63)	Cohen's d	Traditional (n=14)	Modified (n=139)	Cohen's d	Traditional (n=15)	Modified (n=47)	Cohen's d
Total plays	86.7 ± 12.7	138.2 ± 27.0***	2.44	80.7 ± 8.5	113.7 ± 33.2***	1.36	89.8 ± 8.4	97.5 ± 14.2	0.66
Total skill opportunities	342.9 ± 47.0	449.4 ± 93.3***	1.44	301.9 ± 29.9	435.7 ± 116.3***	1.58	343.1 ± 38.3	388.1 ± 73.1*	0.77
Total passes	99.6 ± 13.9	149.4 ± 33.9***	1.92	90.2 ± 13.7	129.7 ± 44.3**	1.21	113.3 ± 13.7	114.8 ± 29.1	0.06
% of effective passes	96.4 ± 3.2	96.3 ± 6.6	-0.02	97.7 ± 1.9	92.7 ± 7.6*	-0.91	98.4 ± 2.0	97.1 ± 3.8	-0.44
Total catches	100.2 ± 12.4	142.9 ± 33.2***	1.71	91.0 ± 12.6	129.6 ± 43.6**	1.20	111.5 ± 13.5	110.1 ± 21.4	-0.08
% of effective catches	96.3 ± 3.3	95.9 ± 4.6	-0.12	97.9 ± 2.6	95.3 ± 5.7	-0.59	98.0 ± 1.6	95.2 ± 4.5*	-0.84
Total tackles	122.5 ± 30.9	131.7 ± 28.9	0.30	104.4 ± 19.1	137.8 ± 43.8**	0.98	108.8 ± 28.2	133.8 ± 33.9*	0.80
% of effective tackles	55.5 ± 17.2	86.5 ± 15.5***	1.89	61.9 ± 12.3	63.3 ± 22.4	0.07	72.5 ± 17.7	57.8 ± 13.2**	-0.94
Total kicks	0.0 ± 0.0	4.5 ± 4.9***	1.30	0.1 ± 0.4	4.9 ± 6.5**	1.03	0.1 ± 0.4	0.7 ± 1.7	0.46
Total knock-ons	4.6 ± 5.8	1.4 ± 2.8**	-0.71	3.8 ± 2.0	2.2 ± 4.7	-0.42	6.7 ± 2.6	3.4 ± 5.3*	-0.79
Around the world runs	16.6 ± 19.4	67.8 ± 29.7**	2.04	2.6 ± 2.1	25.1 ± 25.6**	1.23	13.2 ± 5.8	26.3 ± 21.8*	0.82
Crossed the adv. line	56.7 ± 14.6	113.2 ± 27.3***	2.58	53.4 ± 25.4	80.3 ± 30.3**	0.96	78.6 ± 3.2	74.2 ± 15.4	-0.31
Crossed the def. line	24.1 ± 12.4	64.1 ± 22.8***	2.18	38.9 ± 27.2	54.1 ± 24.4*	0.58	49.1 ± 16.3	39.9 ± 13.8*	-0.61
Line breaks	4.95 ± 5.3	6.16 ± 7.8	0.18	10.3 ± 6.7	12.8 ± 10.0	0.29	3.8 ± 1.7	8.7 ± 7.6*	0.89
Average tackle count	4.5 ± 0.5	4.3 ± 0.7	-0.33	3.9 ± 0.7	3.6 ± 1.1	-0.33	4.2 ± 0.3	4.1 ± 0.7	-0.17
Completed sets	8.0 ± 2.9	13.4 ± 5.7***	1.19	6.9 ± 2.8	6.6 ± 6.9	-0.06	6.7 ± 1.3	8.3 ± 3.8	0.56
Tries scored	9.7 ± 4.3	12.7 ± 7.4	0.49	10.1 ± 3.3	19.8 ± 10.3***	1.27	6.4 ± 2.3	12.9 ± 6.5***	1.32

*p<0.05; **p<0.01; ***p<0.001

1   **Table 3:** Comparison between Traditional, Touch and Tackle Modified Games at the Under 8s Age Category

Category	Traditional (n=14)	Tackle (n=64)	Touch (n=75)	Cohen's d Trad v Tackle	Cohen's d Trad v Touch
Total plays	80.7 ± 8.5	96.3 ± 25.1*	128.5 ± 32.3***	0.83	2.03
Total skill opportunities†	301.9 ± 29.9	403.4 ± 97.7***	463.6 ± 124.2***	1.40	1.79
Total passes	90.2 ± 13.7	107.0 ± 27.4*	149.4 ± 46.8**	0.78	1.72
% of effective passes	97.7 ± 1.9	92.9± 7.4*	92.4 ± 7.8*	-0.93	-0.94
Total catches	91.0 ± 12.6	110.8 ± 30.0*	145.8 ± 47.0**	0.86	1.59
% of effective catches	97.9 ± 2.6	95.3 ± 6.5	95.3 ± 5.0	-0.54	-0.65
Total tackles	104.4 ± 19.1	141.3 ± 47.1**	134.7 ± 40.8**	1.02	0.95
% of effective tackles	61.9 ± 12.3	47.3 ± 14.4***	76.9 ± 18.7**	-1.10	0.95
Total kicks	0.1 ± 0.4	2.69 ± 4.3*	6.8 ± 7.5**	0.83	1.27
Total knock-ons	3.8 ± 2.0	1.9 ± 4.1	2.5 ± 5.1	-0.59	-0.3.2
Around the world runs	2.6 ± 2.1	21.9 ± 21.9**	27.9 ± 28.2**	1.24	1.26
Crossed the adv. line	53.4 ± 25.4	71.2 ± 23*.5	88.1 ± 33.4**	0.73	1.17
Crossed the def. line	38.9 ± 27.2	50.7 ± 22.9	56.9 ± 25.4*	0.47	0.68
Line breaks	10.3 ± 6.7	17.3 ± 9.7*	9.03 ± 8.6	0.84	-0.17
Average tackle count	3.9 ± 0.7	2.9 ± 1.0***	4.1 ± 0.9	-1.18	0.18
Completed sets	6.9 ± 2.8	3.1 ± 4.9*	9.5 ± 7.0	-0.95	0.50
Tries scored	10.1 ± 3.3	24.0 ± 10.8***	16.1 ± 8.3**	1.75	0.95

2   *p<0.05; **p<0.01; ***p<0.001

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