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Motivational climate, intrinsic motivation, psychological need satisfaction, and intensity during FIT FIRST 10 lessons and physical education lessons in the Generation Healthy Kids trial

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Abstract

Background

The purpose of this study was to explore the associations between observed teacher- created motivational climate in the Physical Education (PE) multisport concept FIT FIRST 10 and traditional PE lessons, and pupils' psychological needs satisfaction, intrinsic motivation and movement intensity during the lessons and to compare the motivational climate, levels of needs satisfaction, motivation and training intensity during the FIT FIRST 10 sessions and traditional PE lessons.

Methods

Data was collected, November 2024 to March 2025, during physical activity sessions (FIT FIRST or traditional PE) at 16 of the 23 schools that participated in the larger Generation Healthy Kids study. During the lessons, the teacher-created motivational climate was assessed employing a Danish translation of the validated Multidimensional Motivational Climate Observation System (MMCOS). After the lessons, questionnaires were used to assess psychological need satisfactions and intrinsic motivation of the pupils during the sessions. Polar Team Pro belts were worn by pupils to measure the internal and external training load.

Results

Correlations between the observed motivational climate, basic psychological needs satisfaction, intrinsic motivation and training load, were weak, mostly insignificant, and diverse. FIT FIRST 10 sessions were characterised by higher levels of empowering (needs supportive) climate and lower levels of disempowering climate ($p < 0.05$). However, pupils in control schools reported slightly higher levels of perceived autonomy, competence, and intrinsic motivation during regular PE compared with FIT FIRST 10 in the intervention schools ($p < 0.05$). No significant between-group differences were observed for internal training load and external load measured by Polar Team Pro, where similar moderate-to-high training intensity was observed.

Conclusion

Although FIT FIRST 10 sessions demonstrated a more empowering motivational climate, pupils reported slightly higher psychological need satisfaction and intrinsic motivation in control schools, with no differences in training intensity between conditions.

Background

Physical activity (PA) in schools plays a vital role in promoting pupils' health, wellbeing, and learning. The World Health Organization (WHO) recommends at least an average of 60 minutes of daily moderate- to high-intensity activity, defined by an elevated heart rate that makes speaking difficult,[1] and that activities that strengthen muscle and bone are included at least three times per week.[1] Despite well-documented benefits, including improved cognitive function, social wellbeing, and reduced risk of lifestyle diseases,[2] most children do not meet the internationally recommended guidelines for PA.[3]

Schools have become key settings for PA interventions. Children spend much of their awaken time at school, during which they are often sedentary. Delivering interventions in this setting offers the potential to improve the health status of children and increase the amount of PA they engage in.[4] However, success is not guaranteed when trying to change the PA behaviour of pupils through a school-based intervention,[4] and motivation seems to be a critical factor in the pursuit of enhanced PA, since pupils who are motivated for PA tend to experience greater wellbeing and are more likely to stay engaged in the activities, and thereby elicit higher internal and external load.[5 6]

One intervention which is actively working on the motivational climate is FIT FIRST 10 (FF), a high intensity PA multisport component used in the multicomponent Generation Healthy Kids intervention.[7] FF aims to deliver 40 minutes of intermittent exercise, including high-intensity activity, three times a week during school hours. FF is designed to elevate the heart rate and improve physical, cognitive, and psychological outcomes[8] and, to foster motivation through fulfilment of basic psychological needs as described in the Self-determination Theory (SDT).[9] FF has shown positive effects on children's physical fitness levels[10–12] and can be delivered as a high-intensity, varied PE concept that keeps pupils' heart rates elevated throughout the session, as well as maintaining a high musculoskeletal load.[11 13 14] These physiological benefits and types of training are linked to better health in adulthood, reduced risk of lifestyle diseases, and enhanced cognitive and motor skills, which supports academic performance.[15]

The programme also strives to promote mental wellbeing by integrating a focus on promoting basic psychological needs satisfaction (BPN) during the activities to foster enjoyment of movement, but little is known about the degree of success in this matter. In order to ease implementation by school staff, pre-planned lessons, manuals, and all necessary equipment are provided in the FF program. The FF activities are built around established sports to encourage participation in leisure-time clubs, helping pupils find enjoyable ways to stay active beyond school hours. FF is hypothetically a good

solution for creating a motivational climate and securing BPN satisfaction and a high training load, but its actual impact on the climate and pupils' motivational experiences and training load in a real-world, teacher lead setting is yet to be explored.

Thus, the objectives of the study were to investigate the potential associations between the motivational climate and motivational experiences in FF and PE lessons, as well as internal and external training loads, and to investigate if FF differed from traditional PE in relation to these variables in its implementation as part of the Generation Healthy Kids intervention targeting Danish children from second and third grade.

Methods

Context of the Study – Generation Healthy Kids

This is a sub-study within the research project Generation Healthy Kids (GHK), an extensive, multi-component, multi-setting intervention, which started in September 2023 and ended in June 2025. The GHK intervention aimed at promoting health behaviours, well-being, and learning for Danish pupils aged 6–9 years, by among other things, introducing the FF program three times weekly, providing healthy school lunches and educating children and their parents about healthy sleeping and screen time habits. The present study specifically examines the core PA component in the intervention, FIT FIRST as well as the core component related to PA in the control schools, traditional PE. All teachers at the intervention schools were offered to participate in a 6-hour course with theoretical as well as practical introduction to the programme, including lectures and discussions related to the design of the sessions to elicit high-intensity training and fulfilling basic psychological needs, GHK was approved by the Regional Committee on Health Research Ethics for Southern Denmark (reference number S-20220094) and registered at clinicaltrials.gov (NCT05940675).

In GHK, 24 schools were recruited, and using a cluster randomised design, half of these were randomly assigned as intervention schools. Following randomization, one control school withdrew, resulting in 23 participating schools, 11 control schools, and 12 intervention schools, comprising 2006 pupils aged 6–9 years (i.e., grades 1 to 3). For the present study, all 23 schools were invited of which eleven out of 12 intervention schools (91.7%) and five out of 11 control schools (45.5%) agreed to participate That is, a total of 16 schools, comprising a total of 636 pupils.

Data Collection Procedure

The participating classes were observed twice: once in November/December 2024 and once between January and March 2025. Each visit required two to four trained researchers, depending on the class size: one researcher was responsible for the observation and survey, and another researcher was responsible for measuring the training load using Polar Team Pro (Polar Electro Oy, Kempele, Finland).

At the beginning of the session the pupils were informed of the purpose of the data collection and reminded of their right to withdraw at any point. Only pupils with written parental consent for the full GHK study participated in the present study. Each eligible pupil was then fitted with a Polar Team Pro chest strap whereafter the teacher began the lesson. Each lesson was carefully observed from beginning to end, during which a trained researcher completed an observation sheet for every activity within in the lesson. That is, for each new activity, the teacher created motivational climate was observed and assessed immediately after the lesson, the chest straps were collected and the pupils were asked to complete a short video and smiley supported questionnaire on their acute psychological needs satisfaction and intrinsic motivation during the just-finished FF/PE lesson. The pupils were told that there were no right or wrong answers and that they should respond as they felt best suited to reflect their thoughts, experiences and emotions.

Observational Instrument MMCOS

The observations were conducted using the validated Multidimensional Motivational Climate Observational System (MMCOS), which is grounded in achievement goal theory (AGT) and self-determination theory (SDT).[16] The tool has demonstrated strong inter-rater reliability and validity across three studies; successful application of the tool requires thorough observer training to ensure consistent interpretation.[16]

To ensure alignment, five researchers underwent training by observing and rating PE lessons at a non-participating school. Scores were then discussed to reach a consensus. Inter-rater reliability was confirmed statistically using RStudio, yielding a Cronbach's Alpha of 0.9, indicating high consistency. This supported independent data collection by the trained observers. MMCOS assesses the extent the teacher created climate in a teaching situation is empowering and disempowering. Empowering climate (18 indicator-items) consists of support for autonomy, competence, relatedness, as well as task involvement, whereas a disempowering climate (14 items, divided in three subscales) reflects the opposite and include ego involvement and control. Each of the 32 items is rated on a 4-point scale from 0 ('not at all') to 3 ('strongly').

Acute psychological needs satisfaction and Intrinsic Motivation Questionnaire

To assess pupils' acute experiences of autonomy, relatedness, and competence (basic psychological need satisfaction), as well as intrinsic motivation during FF and regular PE, a questionnaire inspired by two existing instruments was used; the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS)[17] and the Psychological Need States in Sport Scale (PNSSS).[18] As the questionnaire had not previously been used with such a young age group, part of the study aimed to examine its comprehensibility within this population.

The questionnaire comprised 16 items designed to assess acute psychological need satisfaction and intrinsic motivation. Specifically, four items measured intrinsic motivation, five items captured experiences of relatedness, four items assessed autonomy, and three items focused on competence. Two items were reverse-coded, which were visually indicated by inverting the associated smiley icons to signal the opposite response direction. All items were rated on a four-point scale with the response options: “very true for me”, “quite true for me”, “only a little true for me”, and “not true at all”. Each question was supported by a narrated video, and response options were presented using visual smileys to facilitate an intuitive and accessible response process.

Internal and external training load

Heart rates (HR) and activity patterns were monitored at a sampling frequency of 10 Hz using the Polar Team Pro system with a chest belt unit. The HR data were downloaded and expressed as a mean percent of heart rate max (Mean % HRmax) to express the relative internal workload. HRmax was determined from the Yo-Yo Intermittent Recovery Level 1 Children's Test, which has been validated as a relevant tool for field testing among 6–9-year-old children.[19] In addition, the HR data were divided into heart rate zones expressed as % of time spent in the session (% of training time > 80% of HRmax is presented). Moreover, acceleration (Acc) and deceleration (dec) were monitored to express the external training load. Acc/dec > 1.0 m/s^2 was reported.

The reliability and validity of the Polar Team Pro system have been studied in relation to internal and external load and has been described in other studies.[20–22]

Statistical analyses

Data are reported as means (± SD), unless otherwise specified. Correlations between the observed motivational climate, BPNS and physical load variables for each session were conducted using Persons’ r coefficients. Linear mixed (multilevel) modelling (MLM) was used to explore the between-group differences for each outcome and account for the nested structure of the data. MLM analyses were carried out with Jamovi (version 2.6.26), and the full information maximum likelihood method was used to deal with missing data. The full model included fixed-effects for the interaction terms Group x Sex and Group x Klassetrin, and the following covariates: Round (0 = first observations; 1 = second observation), Teacher (PE teacher, other teacher with FF10 course, permanent other teacher without course, substitute teacher without course), Sex (0 = male; 1 = female), class-level (2nd, 3rd), activity time, Total Distance (m), and Group (0 = Control; 1 = FF). Random-effect intercepts were included for Class and School to explore the extent to which Class and/or School clusters account for the explained variance in the outcome variable. Statistical significance levels were set to alpha = 0.05.

Results

Sample characteristics

A total of 636 pupils from 16 schools and 50 classes participated in the study. Of these, 144 pupils (22.6%) belonged to the control group, and 492 pupils (77.4%) belonged to the intervention group. The overall sex distribution was balanced: 323 girls (50.8%) and 309 boys (48.6%). Sex was missing for four pupils in the intervention group.

Across the groups, a total of 98 lessons were observed, comprising 32 control lessons (traditional PE) (32.7%) and 66 intervention lessons (FF) (67.3%). The mean duration of observed lessons was significantly? longer in the control group (M = 47.0 minutes, SD = 9.3) compared with the intervention group (M = 37.6 minutes, SD = 13.1). In total, 599 pupils (94.2%) provided complete questionnaire responses, corresponding to 97.2% in the control group and 93.3% in the intervention group.

Correlations between Motivational Climate, Motivation, and Training Load

The number of accelerations and decelerations, and the distance covered pr. minute was positively correlated with all three types of basic psychological need satisfaction and intrinsic motivation, whereas the time spent ≥ 80% HRmax was only correlated with total basic psychological need satisfaction and competence satisfaction (Table 1).

Table 1.

Correlations between physical activity/load and motivational variables.

	Overall basic psychological need satisfaction	Autonomy satisfaction	Relatedness satisfaction	Competence satisfaction	Intrinsic motivation
Time ≥ 80% HRmax (% of lesson)	0.08*	0.06	0.06	0.07*	0.06
Distance covered per minute	0.12***	0.08*	0.11**	0.11***	0.11**
Acc + dec per minute	0.10**	0.10**	0.07*	0.10**	0.11***

*p < .05, ** p < .01, *** p < .001. Acc = accelerations, Dec = decelerations

Table 2.

Correlations between observed motivational climate and motivational variables.

	Autonomy-supportive	Task-supportive	Relatedness -supportive	Structure	Controlling	Ego-involving	Relatedness-thwarting	Empowering motivational	Disempowering motivational
Overall BPNS	-0.04	-0.04	-0.03	0.00	0.03	0.05	-0.01	-0.04	0.04
Autonomy S	-0.06	-0.05	-0.04	-0.03	0.05	0.03	0.00	-0.05	0.04
Relatedness S	-0.03	-0.03	-0.03	0.02	0.00	0.06	-0.01	-0.02	0.03
Competence S	-0.02	-0.04	0.01	0.01	0.02	0.03	0.00	-0.02	0.03
Intrinsic motivation	-0.06	-0.07*	-0.06	-0.05	0.05	0.07*	0.02	-0.07*	0.07

*p < .05. BPN = basic psychological need, S = satisfaction

Table 3.

Correlations between observed motivational climate and physical activity/load measures.

	Time ≥ 80% HRmax (% of lesson)	Distance covered per minute ($m \cdot min^{-1}$)	Accelerations/decelerations per minute
Autonomy-supportive	-0.15***	-0.15***	-0.17***
Task-involving	0.00	0.08*	0.03
Relatedness-supportive	0.00	0.02	0.04
Structure	-0.05	-0.08*	-0.14***
Controlling	-0.15***	-0.17***	-0.26***
Ego-involving	-0.06	-0.11***	-0.05
Relatedness-thwarting	-0.09**	-0.11**	-0.26***
Empowering motivational	-0.06	-0.04	-0.07*
Disempowering motivational	-0.13***	-0.18***	-0.23***

* p < .05, ** p < .01, *** p < .001.

Motivational Climate, Motivation and Internal Training Load in FIT FIRST vs. PE

The observed teacher-created motivational climate differed significantly between FIT FIRST and control (PE) sessions (Table 4). FIT FIRST sessions were characterized by significantly higher levels of empowering climate and lower levels of disempowering climate.

However, pupils in the control schools reported slightly higher levels of perceived autonomy, competence, and intrinsic motivation compared with pupils in the intervention schools (Table 5).

In contrast, no significant between-group differences were observed for internal training load variables measured by Polar Team Pro (Table 6), including time > 80% HRmax, time > 90% HRmax, and mean % of HRmax.

Table 4
Observed teacher-created motivational climate in intervention (FIT FIRST 10) and control (PE) sessions.

Variable	PE in Control M (95% CI)	FF10 in Intervention M (95% CI)	Difference (%)	P value
Empowering	1.41 (1.34–1.48)	1.81 (1.77–1.85)	+ 28.7	< .001***
Disempowering	0.24 (0.20–0.27)	0.07 (0.06–0.08)	−70.1	< .001***
Autonomy support	0.88 (0.78–0.99)	1.43 (1.38–1.48)	+ 61.4	< .001***
Task-involving	0.82 (0.73–0.90)	1.31 (1.25–1.37)	+ 59.8	< .001***
Relatedness support	1.71 (1.63–1.79)	2.10 (2.06–2.14)	+ 22.8	< .001***
Structure	2.22 (2.14–2.29)	2.41 (2.37–2.45)	+ 8.7	< .001***
Controlling	0.29 (0.23–0.36)	0.10 (0.09–0.12)	−64.6	.040*
Ego-involving	0.28 (0.21–0.35)	0.06 (0.05–0.07)	−80.0	< .001***
Relatedness thwarting	0.14 (0.11–0.16)	0.05 (0.04–0.06)	−61.1	< .001***
*p < .05, **p < .01, ***p < .001. N = 681 (intervention) and N = 220 (control).				

Table 5
Differences in perceived motivational variables between in intervention (FIT FIRST) and control (PE) sessions.

Variable	PE in Control M (95% CI)	FF in Intervention M (95% CI)	Difference (%)	P value
Perceived autonomy	2.87 (2.75–2.98)	2.66 (2.60–2.73)	−7.2	0.003**
Perceived relatedness	3.40 (3.31–3.48)	3.30 (3.25–3.35)	−2.9	0.067
Perceived competence	3.60 (3.52–3.67)	3.47 (3.42–3.52)	−3.5	0.015*
BPN satisfaction	3.31 (3.23–3.38)	3.17 (3.12–3.22)	−4.1	0.007**
Intrinsic motivation	3.38 (3.30–3.46)	3.16 (3.10–3.22)	−6.5	< .001***
*p < .05, **p < .01, *p < .001. N = 692 (intervention) and N = 214 (control).				

Table 6. Differences in internal training load measured by Polar Team Pro between intervention (FIT FIRST) and control (PE) sessions.

Variable	PE control, M (95% CI)	FIT FIRST, M (95% CI)	Difference (%)	P value
Internal load				
Time > 80% HRmax (%)	20.33 (18.36–22.31)	20.75 (19.58–21.91)	2.0	0.871
Time > 90% HRmax (%)	6.30 (5.22–7.37)	5.97 (5.39–6.55)	−5.2	0.256
Mean % of HRmax	67.71 (66.85–68.57)	67.19 (66.68–67.71)	−0.8	0.320
External load				
Meters covered per min	29.03 (27.37–30.69)	30.02 (28.98–31.06)	3.4	0.741
Sprints (n)	0.99 (0.73–1.24)	0.92 (0.79–1.04)	−6.9	0.733
Acc/Dec per min	9.93 (9.60–10.26)	9.66 (9.46–9.85)	−2.7	0.082
*p < .05, **p < .01, *p < .001. N = 768 (intervention) and N = 220 (control).				

Discussion

In our analyses, the correlations between the observed motivational climate, basic psychological needs satisfaction, intrinsic motivation and training load, were weak and diverse Thereby, we couldn't confirm the findings from previous studies, indicating associations between teacher-created climate and perceived needs satisfaction and intrinsic motivation[23 24]. Neither could our hypothesis that an empowering climate and high intrinsic motivation

could lead to high involvement and thereby training load[23 24]. What distinguishes the present study from many earlier studies is the linking of observed teacher-created motivational climate to pupils' perceived experiences of intrinsic motivation within these sessions, as well as their levels of physical activity. This approach addresses a gap identified in the literature search, in which much of the existing research has relied only on pupils' perceptions of the motivational climate or their perceptions of the teacher-created climate (ref). In 2014, Van den Berghe et al. called for more studies of this type to enlighten the unexplored perspectives. These studies are still scarce, but by integrating observations of PE and FF using MMCOS with immediate post-lesson measures of pupils' experiences of motivation, this study contributes to a more robust understanding of how the observed overall motivational climate in the session and participants experiences of needs satisfaction and motivation interact. The present findings call for replications to investigate whether the theories do not apply to this field, or if the methods must be improved.

We observed a more empowering and less disempowering teacher-created climate in FF lessons than in traditional PE, while pupils in PE reported slightly higher acute autonomy, competence, and intrinsic motivation than FF pupils. Meanwhile, heart-rate-based internal load, as well as external load (distance and acc/dec) did not differ significantly between FF and PE. Taken together, these results suggest that a more empowering observed climate does not automatically translate into higher immediate intrinsic motivation and training in younger pupils and that the link between the observed climate and lived experience is context dependent.[9 25 26]

This was quite a surprise, since systematic reviews and meta-analyses show that autonomy-supportive and task/mastery-oriented climates reliably increased need satisfaction and intrinsic motivation in PE, particularly among younger pupils.[24 27] The concurrent pattern of higher pupil-reported intrinsic motivation in PE than in FF indicates a potential mismatch between what is observed and what pupils feel in the moment, a complexity noted in the literature whereby effects vary in relation to implementation quality, measurement tools, and lesson organization.

Firstly, the emphasis on high physiological intensity within FF may inadvertently leave little scope for felt choice, differentiation, and process feedback in younger pupils if such elements are not explicitly embedded in the lesson flow. SDT research indicates that autonomy support together with clear structure yields the strongest engagement; high structure without felt ownership may diminish immediate intrinsic motivation even in well-designed sessions.[9 28] Secondly, qualitative syntheses emphasise the role of peer dynamics: in-the-moment social comparison or teasing can undermine relatedness and enjoyment even when the observed teacher behaviour is inclusive.[29] Thirdly, measuring acute motivation in 8–10-year-olds is psychometrically challenging: ceiling effects and the use of reversed items or scales without a neutral midpoint can compress between-group differences.[17]

The internal load did not differ between FF and PE, and both groups are placed within the expected range in terms of mean HR[30]. The time with heart rates > 80% of individual HRmax was a bit lower than in small-sided ballgames, but higher than in circuit strength training, in previous studies from the present research group, in which the researchers were in charge of the training themselves, and training sessions were the only focus of an intervention. [11 31 32] That indicates that transferring the responsibility of implementing FF to the school staff while also focusing on many other intervention components, as in the present multicomponent intervention trial, could reduce training intensity, but also that the present format, as well as traditional PE has a decent amount of time with high heart rate.

No differences were found in the external training load when comparing traditional PE and FF10, and both elicited an expected amount of total distance and accelerations/decelerations when comparing to FF10 in the Faroe Islands[14]. No other studies to our knowledge reported these variables in a representative sample during traditional PE, but to set it into perspective, it is higher than found in a study of PE classes combining CrossFit training and ball games, but lower than in classes only using ball games, as well as recreational soccer and team handball.[33–36]

Strengths and limitations

MMCOS is robust and widely used but has largely been validated using older cohorts; in lower primary school pupils, certain domains (e.g. autonomy) can manifest differently. Measuring acute need satisfaction in younger children is difficult; instrument tailoring (e.g. five-point scales with a neutral midpoint) is advisable. Our HRmax estimation via Yo-Yo IR1C is appropriate for 6–10-year-olds, whereas the indoor external-load metrics (speed/distance) from Polar Team Pro warrant caution due to known validity limitations at higher intensities.[16 19 20]

Strengths include the multi-method design (observations plus acute self-report and objective measures of training load) in an ecologically valid school setting across many classes. Limitations include potential ceiling/floor effects, age-related response challenges for acute motivational states, the focus on immediate (rather than sustained) outcomes, and possible observer expectancy given familiarity with the intervention, an inherent risk in field studies, which future work should mitigate with blinded observations.[17]

The case that only approximately half of the GHK control schools accepted to participate in this additional sub study implies a risk for a selection bias, since, at least one school did not want to participate due to the reason that they felt that their PE teaching did not work well, and gave that as the explanation to not accept us to visit and observe. Thus, the observations of traditional PE might not be representative for all schools in Denmark. Another risk of bias is the fact that the session did not had the same duration. FIT FIRST lessons aimed at 40 min. of activity, but due to time constraints they lasted from 20 to 40 minutes, whereas the PE lessons had 30 to 60 minutes of PA.

Conclusion

The present study shows that FIT FIRST lessons were characterized by a more empowering observed climate than in traditional PE, although this did not translate into higher acute intrinsic motivation nor higher training load among pupils. These findings highlight the complexity of linking observed teaching behaviours to pupils' immediate psychological experiences and physical activity behaviour. Methodological and developmental factors, particularly the challenges of assessing acute motivation in younger children, likely contribute to these patterns.

Declarations

Ethics approval and consent to participate: The study was approved by the Regional Committee on Health Research Ethics for Southern Denmark (reference number S-20220094) and registered at clinicaltrials.gov (NCT05940675).

Consent for publication: Was given as part of the consent to participate in the study.

Availability of data and materials: Data is available upon reasonable request to the corresponding author

Competing interests: None to declare

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Authors' contributions: Funding acquisition; GN, JLJ, PK. Design; MNL, JAS, VES, PSM, GN, PK. Data collection; MNL, JAS, VES, PSM, KPO, MK, PSM, MGC, CBM, GJJ, MIA. Analysis; MNL, PSM, MGC, GT, GJJ, LGJ. Writing original draft; MNL, JAS, VES. Critical revision; All authors.

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