International Journal of Science and Research Archive

eISSN: 2582-8185

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

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Hyperopic tactics: Evaluating the effects of intentional constraints on collegiate soccer players' physical capabilities and temperaments

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International Journal of Science and Research Archive, 2024, 11(02), 1102–1115

Publication history: Received on 07 February 2024; revised on 15 March 2024; accepted on 18 March 2024

Article DOI: https://doi.org/10.30574/ijsra.2024.11.2.0458

Abstract

This study, the second year in a longitudinal study, further examined the influence of constraints on the practice performance of collegiate soccer players, mediating role of the player's individual temperament. Eighteen players from a geographic Midwest NCAA Division II university completed the Personality Plus test to establish their temperaments and measured their practice regiment performance using Game Performance Assessment Instrument. Data were collected across three rounds during the soccer season, involving input constraints, output constraints, and a constraint-free control condition. The results revealed significant performance differences between constraint trials and the control trial. For the second consecutive year, the data did not reveal any statistically significant correlation between temperaments and constraint influences, challenging the notion that temperaments effect on an individual's response to constraints. The study underscores the importance for coaches to optimize training regimens and practice conditions by recognizing constraints' impact on performance, suggesting that temperament may not be the primary mediating factor. These results have shifted the researchers' focus on the importance of communication, specifically how the message is interpreted and applied- possibly because of individual temperament. A new model, CECA provides a promising framework for understanding how coaching influences the problem space. This research provides valuable insights into how constraints affect NCAA Division II soccer players' performance, guiding coaches and sports professionals in tailoring effective training methods and constraints for enhanced player performance and overall team success.

Keywords: Constraints; Performance; Temperament; Motivation style

1. Introduction

The objective of enhancing athletic performance through effective coaching is relevant to the current research. Balancing academic pressure and practice regiment exposes collegiate athletes to unique pressures that risk their future development (Xanthopoulos et al., 2020). This is the second year of a longitudinal quasi-experimental study, a continution of the work conducted by Hinchman et al. (2023), aimed to examine the continued relationship between designed constraints and physical performance, as mediated by temperament and personality attributes. The constraint-based model of novelty (C-BMN) devised by Stokes (2009) served as the conceptual framework for this study, as it postulates that designed constraints have beneficial effects on the creative process and production. The C-BMN (Stokes, 2009) consists of four core concepts: the creativity problem, constraints, variability, and problem spaces. Constraints increase novelty and performance by requiring individuals to reframe, redesign, and redirect their cognitive pathways in order to complete the assigned task (Hatchuel & Chen, 2017; Haught-Tromp, 2017; Stokes, 2009, 2013). The application of designed constraints facilitates the creation of innovative products and movements (Caniels &

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Rietzschel, 2015; Haught, 2015; Haught-Tromp, 2017; Torrents-Martin et al., 2015), with consistent practice with paired constraints an individual can generate new actions (Torrents-Martin et al., 2015). Individuals with prior experience working with constraints are redirected to make fresh and innovative discoveries as problem spaces become more malleable (Caniels & Rietzschel, 2015; Roskes, 2015). Enhancing novel performance and production will require constraints that are paired with temperament. Using the concepts outlined in Stokes' C-BMN, this study seeks to determine which constraint type will improve the performance of an NCAA Division II athlete.

The present study employs the C-BMN framework (Stokes, 2009) as it has been shown in the literature to enhance an individual's ability to generate innovative solution pathways, related products, and physical performance that are pertinent to the current research (Caniels & Rietzschel, 2015; Haught, 2015; Haught-Tromp, 2017; Torrents-Martin et al., 2015). Consistent implementation of constraints by individuals facilitates the creation of a flexible problem spaces, which in turn steers them towards the generation of innovative and distinctive solution approaches (Caniels & Rietzschel, 2015). The need for novel methodologies to tackle intricate problems arises from the presence of constraints, as suggested by various scholars (Hatchuel & Chen, 2017; Haught, 2015; Stokes, 2008, 2013; Torrents-Martin et al., 2015). After the discussion of temperaments, the beneficial effects of constraints and Stokes' C-BMN are deliberated.

Temperament has been defined as the controlling features and early developing of individual differences in tendencies to experience and express emotion (Molfese & Molfese, 2015). Additionally, it has been described as the innate, heritable, and core aspect of an individual's personality (Abrams, 2012). As such, temperament primarily reflects the neurobiological profile that an infant receives from their parents, including genes, with environmental conditions surrounding the mother during pregnancy contributing to the remaining variability (Abrams, 2012, p.58). Understanding the variations in temperament and other affective characteristics among individuals is imperative in comprehending the human personality (Merenda, 1987).

While there are several commonalities between temperament and personality, it is widely agreed upon that temperament serves as the enduring and biological basis of personality (Deal, Halverson, Havill, & Martin, 2005). According to a conventional view, temperament traits are primarily distinct and typically stable throughout an individual's lifetime (Strelau, 1987; Thomas & Chess, 1977). Conversely, personality traits are acquired gradually through life experiences. According to Allport's (1961) perspective, temperament is primarily based on innate characteristics, and thus has a strong genetic basis. Mammadov, Cross and Cross (2019) posit that personality traits are developed based on the combination of temperament and experience.

Understanding a player's temperament can facilitate effective communication and foster a positive coach-player relationship. The characteristics of temperament can be defined by the following four factors: (a) the individual's capacity to process information at a rapid or leisurely pace at the psychological level; (b) the individual's ability to endure stress or various forms of exertion; (c) the individual's equilibrium; and (d) the display of affective processes in diverse circumstances (Romilia et al., 2020). In 1893, Wundt made alterations to the Kant-Galen-Hippocrates four model, resulting in the classification of individuals into the sanguine, choleric, melancholic, and phlegmatic categories. Presently, the classification of temperaments is based on Galen's four types (Merenda, 1987) and defined in Table 1.

Table 1 Temperament Character Traits

	Choleric	**Sanguine**	**Phlegmatic**	**Melancholy**
Strengths	Dominate Goal Oriented Strong-Willed Decisive Independent Exudes Confidence Takes Charge	Strong Even Tempered Boisterous Good Listener Enthusiastic High Energy Inspiring Sincere	Inoffensive Easygoing Patient Adaptable Personality Reliable Mediator Good Listener	Analytical Conscientious Sensitive Gracious Schedule Oriented Perfectionist Big Picture View Behind the Scenes
Weaknesses	Quick Tempered Impetuous Manipulative Inflexible	Loud Mouth Head Strong Quick Tempered Easily distracted	Irresponsibility Selfish Too Compliant Lacks Self-Motivation	Self-Image Critical Self-Centered Hard to Please Selective Hearing

	Domineering Unapologetic	Center of Attention Fragile Confidence	Resists Change Discouraging Judgmental	Grudge Holder Standoffish Insecure Highly Critical

Table adapted from Littauer, F. (1981), Littauer, F. & Sweet, R. (2011), and Merenda (1987).

Stokes' (2009) C-BMN serves as the conceptual framework for this study. Stokes C-BMN is predicated on the following fundamental concepts: (a) the problem, (b) constraints, (c) variability, and (d) problem spaces.

- **The Problem.** Stokes (2006) asserts that the process of problem-solving involves the use of strategic planning and structure. The problem begins as an unstructured problem, and its resolution is contingent on the how the problem solver utilizes constraints imposed. The imposition of tactical constraints on the problem space serves to limit conventional solutions while promoting the emergence of creative ones (Stokes, 2006).
- **Constraints.** Constraints are obstacles that prevent an individual from easily resolving a problem (Stokes, 2006). Constraints influence individual productivity by compelling them to rethink, rework, and reroute mental processes to complete the proposed task (Hatchuel & Chen, 2017; Haught-Tromp, 2017; Stokes, 2006, 2007, 2008, 2009, 2010, 2013). The problem-solver uses constraints as tools to creatively solve the problem (Stokes, 2006). These tools are available in pairs, is hierarchical in nature, and are domain-specific (Stokes, 2006). By simplifying the process through guided direction, constraints assist novices in maximizing their performance (Torrents-Martin et al., 2014).
- **Variability**. The term "variability" refers to number of appropriate and successful solution pathways and the scope of the problem space (Stokes, 2006).
- **Problem Spaces**. The problem space comprises the guidelines or actions necessary to resolve and issue or complete a task (Stokes, 2008). Constraints employ a two-fold effect on the problem space: (a) they can expand the array of accessible solutions available to the individual, and (b) they can limit the permissible solution paths to resolve the task (Reitman, 1965).

Simon (1973) explored how an individual attempts to solve typical problems, a well-structured and ill-structured. A well-structured problem is characterized by: (a) clear benchmarks, (b) at least one definable problem space, (c) sequential and achievable steps, (d) discernable development phases, and (e) assimilation of new knowledge derived from solving the problem. A solvable problem must include at least one path that outlines the process that were altered during the solution process at each stage within the problem space. Every problem initially presents itself as an ill-structured problem, until it is restructured by the individual into one that is well-structured. Restructuring the problem requires a strategic approach that involves dividing the problem space into small segments, enabling an individual to tailor their approach and develop distinctive solution pathways. A problem space without constraints, free of limitations, can be counterproductive resolving a problem. A problem space devoid of constraints provides an individual with an infinite array of options that can obscure resolution pathways and hinder problem-solving process. Constraints within the problem space are necessary, enabling individuals to restructure the ill-structured problem into a well-structured one (Simon, 1973).

Reitman (1965) deemed constraints as essential in problem-solving process through the composition of a fugue. How constraints are combined and arranged influence the problem space, determining the viable routes an individual takes in resolving a problem (Reitman, 1965). Within the problem space, the guidelines and steps are included to properly solve an assigned problem or task (Goel & Pirolli, 1992; Newell & Simon, 1973; Stokes, 2008). Constraints affect the problem space in two distinct ways: (1) they expand the array of solution paths available to the individual; (2) they simultaneously restrict the suitable range of solution paths. Each problem space contains of set of defined constraints needed to be considered to resolve. A domino effect occurs as an individual navigates the problem space utilizing and applying these dual constraint types to resolve the prescribed task. The constraints provide the problem space boundaries, guiding the individual along different solution pathways until the problem is resolved or abandoned (Reitman, 1965).

Constraints that influence the early stages of the resolution process are known as input constraints, while those that influence the final product are referred to as output constraints (Rosso, 2014). Input, or process constraints, influence the way an individual approaches a problem space and the strategies that can be utilized to resolve the task. Onarheim (2012) introduced the concept of blackboxing, an input constraint, where individuals quickly identify and concentrate on only the elements that can be manipulated to resolve the task. Input constraints encompass all the essential elements needed to finish a task, including time, raw materials, equipment, and financial resources (Stokes, 2013). These guide individuals through the problem space, allowing them to focus on distinct elements that can be utilized to solve the problem or complete the task (Stokes, 2013).

Output constraints are defined as any restrictions or limitations that reduce the range of suitable options or alternatives an individual has for accomplishing a task or resolving a problem (Rosso, 2014). These constraint types restrict the range of results and outcomes of the final product or decision by outlining the resolution's requirements; they restrict the focus on specifically defining what is ultimately acceptable (Stokes, 2013). Acceptability is established by both the field and broader domain through the process of gatekeeping. Gatekeeping within any field serves as the ultimate output constraint, determining the types of responses and products that are permissible (Csikszentmihalyi et al., 2018). To illustrate, when coaches consistently endorse or criticize a player’s movement or technique, they act as gatekeepers. Coaches set the standards that decide an acceptable performance.

The purpose of this study gave rise to the following overarching research question: Does the performance of NCAA Division II soccer players change as a result of designed constraints that mediate through temperament? Specifically, this research sought to answer the following research questions (RQ):

RQ1*:* Will there be a statistical difference between the means of the rubric scores of the input-constraint, output-constraint, and the control in terms of performance of NCAA Division II soccer players?

***H₀*1:** No difference exists in performance between the output constraint, input constraint, and control.

$\mu_1 = \mu_2 = \mu_3$

***Hₐ*1:** There is a difference between the input constraint trial, output constraint trial, and control trial concerning performance.

$$\mu_1 \neq \mu_2 \neq \mu_3$$

RQ2: Will there be a statistical difference between the means of the rubric scores of the input-constraint and the control in terms of performance?

***H₀*2:** The mean performance level of soccer players with an input constraint will be the same as the control.

$$\mu_1 = \mu_2$$

***Hₐ*2:** The mean performance level of soccer players with an input constraint will be higher than the control.

$$\mu_1 > \mu_2$$

RQ3*:* Will there be a statistical difference between the means of the rubric scores of the output-constraint and the control group in terms of performance?

***H₀*3:** The mean performance level of soccer players with an output constraint will be the same as the control.

$$\mu_1 = \mu_2$$

***Hₐ*3:** The mean performance level of soccer players with an output constraint will be higher than the control.

$$\mu_1 > \mu_2$$

RQ4*:* Will a soccer player’s temperament (introvert or extrovert) effect soccer performance?

***H₀*4:** No difference exists in constraint influence.

$$\mu_1 = \mu_2 = \mu_3$$

***Hₐ*4:** There is a difference constraint influence based on the player’s temperament.

$$\mu_1 \neq \mu_2 \neq \mu_3$$

2. Material and Method

2.1. Participants

During the fall soccer season, twenty-two NCAA Division II players from a convivence sample, were invited to participate in this study. In total, *n* = 18 elected to participate where four identified as a forward (22.2%), eight identified as a midfielder (44.4%), five identified as a defender (27.8%), and one identified as a goalkeeper (5.6%) as shown in Table 2.

Table 2 Participant Position Distribution

Position	***n***	**%**
Forward	4	22.2
Midfield	8	44.4
Defense	5	27.8
Goalkeeper	1	5.6

2.2. Measures

2.2.1. Game Performance Assessment Instrument

This study again utilized the Game Performance Assessment Instrument (GPAI; Oslin et al., 1998) to assess player performance on teamwork/supporting behavior, position/direction, trapping, dribbling, passing, and total performance. The GPAI utilized the same adaptation as the previous study (Hinchman et al., 2023) to ensure consistency in the data analysis. The rubric rating scale was also identical, rating from 0 to 20, with 0-4 indicating below expectations, 5-9 indicating needs improvement, 10-15 indicating meets expectations, and 16-20 indicating exceeds expectations. Alignment and content validity was calculated using the Lawshe's content validity ratio (CVR; Ayre & Scally, 2014). Specifically, a CVR value of 0.90 or higher was considered acceptable for construct and measurement alignment. The GPAI rubric was found to have a CVR value of 1.0, indicating strong alignment and adequate content validity.

2.2.2. Florence Littauer's Personality Plus

The Personality Plus test developed by Florence Littauer (LPP) assesses an individual's temperament through a 40-question survey. The questions present a list of adjectives, divided into four columns. The respondent circles the words in each column that best describe themselves. After completing the survey, the responses are tallied on an answer sheet. The column with the most selections indicates the respondent's dominant temperament - either Sanguine, Choleric, Melancholic or Phlegmatic.

2.3. Procedure

GPAI data were collected over three practices over three weeks during the middle of the soccer season. The practices were identical in structure and started with basic warm up drills for approximately 20 minutes followed by the data collection round lasting for 10-15 minutes. The data collection rounds involved a structured drill that was modified using a constraint type for two rounds compared to a constraint-free rondo drill. A rondo soccer drill consists of a group of players forming a circle around one or two "defenders" who remain in the center. The remaining players, known as "attackers," attempt to keep the ball away from the defenders by passing the ball to one another. The objective is for the attackers to maintain possession during the drill. The first data collection involved a passing box drill utilizing input constraints, the second data collection involved output constraints, and the third data collection utilized no constraint rondo drill.

The input constraints utilized in the first data collection round involved specific touches and sequences that the players complete for success. Attackers were required to have two touches on the ball and pass in the following sequence: outside player to inside player back to an outside player to restart the sequence. The output constraints utilized in the second data collection round involved a prescribed distance between players in a 10v7 requiring players to pass at a specific angle and velocity. The final collection round involved the constraint-free (control) rondo drill with no constraints.

Researchers administered the LPP test at the onset of the study (week 1) before the first GPAI test. To address potential language barriers during the assessment, participants were provided a supplementary document of definitions of terminology.

2.4. Treatment of Data

The Statistical Package for Social Sciences (IBM SPSS Statistics, 2020) was used to analyze the descriptive data. A one-way repeated measures ANOVA was used to analyze the sub-components and total GPAI rubric scores. A two-way mixed ANOVA to evaluate GPAI change in a participants LPP temperament score. Post hoc tests were conducted when appropriate with a significance at an alpha at .05.

Prior to final data analysis, four participants were removed from analysis due to their inability to complete the three trials due to non-participation caused by injury or absence. The small sample size (n = 18) of LPP scores, participants' LPP personality categories were again combined to utilize the two overarching categories of Extrovert (Sanguine & Choleric) and Introvert (Melancholy & Phlegmatic) for final analysis (Littauer, 1992).

3. Results

As previously stated, this quantitative study's purpose was to examine how designed constraints influence athletic performance mediated through their temperament. To compare the differences, this researcher generated research questions that were particular to the topic and study's theoretical framework. Results are presented below by research questions.

3.1. RQ 1. Will there be a statistical difference between the means of the rubric scores of the input-constraint, output-constraint, and the control in terms of performance of NCAA Division II soccer players?

To address Hypothesis 1, a one-way repeated measures ANOVA was conducted whether there was a statistically significant difference in physical performance over the course of constraint intervention for each dimension and total GPAI. Table 3 reports the GPAI Total mean rubric scores for NCAA Division II soccer athletes. Table 4 reports the GPAI subdimension mean rubric scores for NCAA Division II soccer athletes. The constraint intervention elicited statistically significant changes in teamwork over time, $F(1, 17) = 1160.190$, $p < .001$, partial $\eta^2 = .986$; passing over time, $F(1, 17) = 1084.413$, $p < .001$, partial $\eta^2 = .985$; position/direction over time, $F(1, 17) = 968.471$, $p < .001$, partial $\eta^2 = .983$; trapping over time $F(1, 17) = 1085.982$, $p < .001$, partial $\eta^2 = .985$; dribbling over time $F(1, 17) = 1085.982$, $p < .001$, partial $\eta^2 = .980$; and total GPAI $F(1, 17) = 1458.636$, $p < .001$, partial $\eta^2 = .988$.

Table 3 GPAI Total Scores by Constraint Type

Constraint Group	*n*	Mean	Std. Deviation
Total GPAI Control	18	48.5000	14.95188
Total GPAI Input	18	73.7222	13.2567
Total GPAI Output	18	82.8889	6.52496

Table 4 GPAI Sub-Dimensions Scores by Constraint Type

Constraint Group	*n*	Mean	Std. Deviation
Teamwork Control	18	9.11	3.79
Teamwork Input	18	14.94	2.79
Teamwork Output	18	15.94	2.99
Passing Control	18	9.72	3.55
Passing Input	18	14.50	3.29
Passing Output	18	16.67	1.85
Position/Direction Control	18	9.50	3.55
Position/Direction Input	18	14.33	3.50
Position/Direction Output	18	16.50	1.54
Trapping Control	18	9.61	3.52
Trapping Input	18	14.67	2.89
Trapping Output	18	16.78	1.69
Dribbling Control	18	10.56	3.62
Dribbling Input	18	15.28	3.30
Dribbling Output	18	17.00	1.45

RQ1 asked if be a statistical difference existed between the means of the rubric scores of the input-constraint, output-constraint, and the control in terms of performance of NCAA Division II soccer players. Results of ANOVA indicated a statistical significant difference between constraint trials for the Total GPAI and the GPAI subdimensions. Based on the results, the null hypothesis was rejected and the alternate hypothesis is accepted. The effect size demonstrated a large effect size (Cohen, 1988).

3.2. RQ 2. Will there be a statistical difference between the means of the rubric scores of the input-constraint and the control in terms of performance?

Tukey's post hoc tests were conducted for ANOVA statistics. Findings from Hypothesis 1 indicated that the Total GPAI and all GPAI subdimensions were significant at $p < .05$. Results of the Tukey post hoc comparison tests for the mean Total GPAI rubric scores, mean teamwork subdimension rubric score, mean passing subdimension rubric scores, mean position/direction subdimension rubric scores, the mean trapping subdimension rubric scores, and mean dribbling subdimension rubric scores are represented in Table 5.

Table 5 Tukey Post Hoc Comparison of Total GPAI Rubric Scores

Time 1-Time2		Mean Difference	Std. Error	Sig.
Total GPAI	Total Input Constraint-Control	-25.22	4.011	<0.001*
	Total Output Constraint-Control	-34.389	3.994	<0.001*
	Input Constraint-Output Constraint	-9.167	3.572	0.06
Teamwork	Total Input Constraint-Control	-5.833	1.07	<0.001*
	Total Output Constraint-Control	-6.833	1.22	<0.001*
	Input Constraint-Output Constraint	-1.000	1.08	1.00
Passing	Total Input Constraint-Control	-4.78	0.827	<.001*

	Total Output Constraint-Control	-6.94	0.876	<0.001*
	Input Constraint-Output Constraint	-2.17	0.868	0.069
Position/ Direction	Total Input Constraint- Control	-4.83	1.06	<0.001*
	Total Output Constraint-Control	-7.00	0.929	<0.001*
	Input Constraint-Output Constraint	-2.17	0.933	0.099
Trapping	Total Input Constraint- Control	-5.06	1.04	<0.001*
	Total Output Constraint-Control	-7.17	0.837	<0.001*
	Input Constraint-Output Constraint	-2.11	0.771	0.042*
Dribbling	Total Input Constraint- Control	-4.72	0.812	<0.001*
	Total Output Constraint-Control	-6.44	0.915	<0.001*
	Input Constraint-Output Constraint	-1.722	0.795	0.135

*Significant at $p<.05$

RQ2 asked if there existed a statistical difference between the means of the rubric scores of the input-constraint and the control in terms of performance. The results indicated a statistical difference in the Total GPAI and all subdimensions therefore the null hypothesis was rejected and the alternate hypothesis is accepted.

3.3. RQ 3. Will there be a statistical difference between the means of the rubric scores of the output-constraint and the control group in terms of performance?

RQ3 asked if there existed a statistical difference between the means of the rubric scores of the output constraint and the control in terms of performance. The results indicated a statistical difference in the Total GPAI and all subdimensions therefore the null hypothesis was rejected and the alternate hypothesis is accepted.

3.4. RQ 4. Will a soccer player’s temperament (introvert or extrovert) effect soccer performance?

RQ4 asked if there existed a difference in constraint influence based on a player’s temperament. Table 6 outlines the temperament break down of the current participants based the LPP scores. A two-way repeated measures ANOVA was run to determine the effect of temperament on the soccer performance as measured by the GPAI. Mauchly's test of sphericity indicated that the assumption of sphericity was met for the two-way interaction, $\chi^2(2) = .418$, $p = .811$. As shown in Table 7, the players Total GPAI rubric scores are sub-divided into those identified as extrovert and introverted by the LPP. There was no statistically significant two-way interaction between temperament and constraint effect, $F(1.961, 43.149) = .807$, $p = .451$.

Table 6 Temperament Category Breakdown

Temperament Type	N	%
Extrovert	12	66.7
Sanguine	6	33.3
Choleric	6	33.3
Introvert	6	33.3
Melancholy	4	22.2
Phlegmatic	2	11.1

Table 7 Measure Temperament

Source		Type III Sum of Squares	df	Mean Square	*F*	Sig.
Constraint * Temperament	Sphericity Assumed	212.528	2	106.264	0.807	0.453
	Greenhouse-Geisser	212.528	1.961	108.359	0.807	0.451
	Huynh-Feldt	212.528	2	106.264	0.807	0.453
	Lower-bound	212.528	1	212.528	0.807	0.379
Error (Constraint)	Sphericity Assumed	5791.944	44	131.635		
	Greenhouse-Geisser	5791.944	43.149	134.230		
	Huynh-Feldt	5791.944	44	131.635		
	Lower-bound	5791.944	22	263.270		
Constraint	Sphericity Assumed	14054.194	2	7027.097	53.383	<0.001*
	Greenhouse-Geisser	14054.194	1.961	7165.646	53.383	<0.001*
	Huynh-Feldt	14054.194	2	7027.097	53.383	<0.001*
	Lower-bound	14054.194	1	14054.194	53.383	<0.001*

*Significant at $p<.05$

LPP data collected on the n = 18 soccer players found that a majority of participants were identified as extroverts (n = 12, 66.7%) which were divided equally between the categories sanguine (n = 6) and choleric (n = 6). The participants identified as introverts (n = 6, 33.3%) were not equally divided between melancholy (n = 4) and phlegmatic (n = 2). Results are represented in Table 8.

Table 8 LPP Confidence Intervals

				95% Confidence Interval	
Temperament	**Constraint**	**Mean**	**Std. Error**	**Lower Bound**	**Upper Bound**
Extroverted	Control	45.917	4.242	37.120	54.713
	Input	73.333	3.812	65.428	81.238
	Output	82.917	1.974	78.823	87.010
Introverted	Control	53.667	4.242	44.870	62.463
	Input	74.500	3.812	66.595	82.405
	Output	82.833	1.974	78.740	86.927

4. Discussion

The current study examined the relationship between predetermined constraints and physically performance, as adjusted by individual temperament and personality traits.

The study's value lies in its focus on how coaches and other athletic personnel can restructure practice to maximize performance and minimize monetary cost. It is vital to gain an insight into how collegiate athletes react when introduced to deigned constraints. We found that both input and output constraint differences were statistically different from the control in all Total GPAI and all its subdimensions. This finding is consistent with previous research that constraints can be utilized to maximize physical performance (Hinchman et al., 2023; Torrents-Martin et al., 2014). The study did not indicate a statistically significant difference in Total GPAI performance adjusting for individual temperament corroborating the first-year data of this longitudinal study (Hinchman et al., 2023). A review of literature, however, indicates that temperament should be considered to improve physical performance (Abduyeva, 2021). Our findings contribute to the study of constraints of improving collegiate physical performance in the context of practice regiment manipulation.

The study's results indicate that constraints can be utilized to maximize performance regardless of temperament. The present study aligns with previous research on performance that is theoretically grounded in Stokes' (2009) C-BMN, as evidenced by the statistically significant difference observed between the constraints and control conditions. Despite the existence of a significant body of literature on the utilization of constraints (Caniels & Rietzschel, 2015; Haught, 2015; Haught-Tromp, 2017), the researcher was unable to identify any investigations that have examined the efficacy of Stokes' (2009) C-BMN on college athletes beyond the author's original study (Hinchman et al., 2023). This research makes a valuable contribution to the existing literature on constraints and performance by proposing a framework based on Stokes' (2009) C-BMN that can be utilized to enhance a coach's ability to improve physical performance by manipulating constraints.

The study did not indicate a statistically significant difference between the control group and those subjected to constraints, even after adjusting for temperament. Existing research suggests that cognitive and affective factors play a role in how individuals approach a given problem space (Mischel & Shoda, 1995; Roskes, 2015). The interaction between unconscious and conscious mediating processes determines behavior and responses to external stimuli, with individuals being influenced by both their personality and the nature of the problem space itself. The interaction between their personality and environment shapes their strategies and behaviors for resolving the problem space. Essentially, the problem space varies for each individual, as their perception focuses on different facets, leading to shifts in their resolution strategies (Mischel & Shoda, 1995).

Table 9 Alignment of Temperaments to Problem-Space Motivation & Constraint-Type

Temperament		**Problem-Space Motivation**	**Constraint-Type**
Extroverts	Sanguine: Temperament that is characterized as strong, balanced, mobile, and adaptable (Ekstrand, 1995; Lester, 1990; Romilia et al., 2020) Choleric: Temperament that is characterized as dominant, energetic, quick thinker, and a doer (Ekstrand, 1995; Lester, 1990; Romilia et al., 2020).	Task-Approach: Individuals with an approach-motivated mindset are relentless in their pursuit of success and reward, unconcerned with constraints and constraints (Roskes, 2015). Obstacles are viewed positively, and any difficulties encountered within the problem space are viewed as opportunities to be overcome and subdued (Roskes, 2015).	Input Constraints: Process constraints that direct an individual's approach to the problem space (Stokes, 2006; Rosso, 2014).
Introverts	Phlegmatic: Temperament that is characterized as calm, quiet, self-controlled, and avoids conflict (Ekstrand, 1995; Lester, 1990; Romilia et al., 2020). Melancholic: Temperament that is characterized as sensitive, introverted, and difficulty with dealing with stress (Ekstrand, 1995; Need citation in the reference page; Romilia et al., 2020).	Task-Avoidance: Individuals who adhere to an avoidance motivational strategy exhibit nervousness, stress/anxiety, caution, and the use of prescribed algorithmic solution pathways (Roskes, 2015).	Output Constraints: Product constraints restrict the number of acceptable solutions to the problem space (Stokes, 2013; Rosso, 2014).

Roskes (2015) established a correlation between constraints and motivation by examining how their interplay impacts an individual's production. An individual's motivation is delineated into two different categories; (1) task approach; or (2) task avoidance. Task-approach motivated individuals persistently work toward accomplishment and rewards, unconcerned with obstacles and constraints. In the problem space, constraints are perceived positively, and any difficulties are there simply to be bypassed and mastered. The task-avoidance motivation perspective posits that constraints are perceived as negative obstacles that hinder the creative process and prevent individuals from effectively accomplishing the task. Table 9 provides an alignment of temperaments to problem-space motivation.

The ultimate objective for competitive athletes is to achieve peak performance during a contest (Cohn, 2009, as cited in Zhang et al., 2019). To achieve this objective, coaches need to comprehend various facets of their athletes' daily training routines, including the training environment and its potential influences. According to Zhang et al. (2019), evaluating an athlete's capacity to effectively train within their environment depends on factors such as managing distractions, adapting to challenges, and receiving thorough preparation.

An athlete's performance in their sport can also be influenced by their psychological acumen and their role within the team (Gyomber et al., 2013). Hence, gaining insight into an athlete's mental processes could shed light on their emotions, thoughts, and behaviors. Understanding how these aspects relate to an athlete's individual personality can prove beneficial not only for the individual but also for the team and coaches (Ioan & Mihaela, 2010). Stanford et al. (2022) revealed that the personalities of team members, including the coach, significantly affect the emotions, viewpoints, and conduct of each individual. Consequently, this interplay has both direct and indirect ramifications on the athlete's performance.

4.1. Future Research

In the realm of improving physical performance through practice, constraints have proven effective over the past two years, surpassing initial expectations. However, focusing solely on this myopic aspect is insufficient for broadening its relevance to various programs and sports. To gain a deeper understanding, it is crucial to explore how individuals maneuver through the problem space in the dynamic context of live gameplay. This shift requires us to investigate how communication is interpreted and information is applied, with specific attention to the temperaments of both coaching staff and players.

In coaching a game, it is crucial for the coach to have confidence that the players are executing the game plan on the field. This necessitates an effective communication system between players and coaches. The “directed telescope” is a military concept describing the methods a commander utilizes to gather information and provide tactical orders (Van Creveld, 1979). This "top-down" approach allows information to flow from lower levels to the leader, enabling the coach to have comprehensive insight into the problem-solving techniques employed by the players. The better the players are trained, the more information they can share with the coaches and assistant coaches. Essentially, the "directed telescope" affords coaches the opportunity to address multiple challenges simultaneously through ongoing communication.

To better understand the effectiveness of coaching, it is necessary to adopt a new conceptual model. The CECA Model (Bryant, 2006) offers a potential avenue for gaining insights into how to train players to navigate the problem space effectively. The CECA Loop directs the players' attention to compare the in-game situation with their training, prompting them to develop new strategies to handle the stresses and pressures of the game (Bryant, 2006).

In coaching, the CECA Loop follows a four-step path:

- The coach initiates a game plan by identifying ideal attacking and defending scenarios.
- Once the game begins, players (and assistant coaches) gather information by observing how the opposing team responds to the initial gameplay, relaying this information back to the head coach.
- The head coach compares the ideal scenarios with the actual gameplay, determining necessary adjustments to achieve an optimal outcome.
- Leveraging the "directed telescope," the head coach adapts the gameplay to effectively address the game plan and players' efforts.

This structured approach enables coaches to continuously assess, adapt, and optimize their strategies based on real-time information, enhancing the overall effectiveness of coaching methods.

The effectiveness of the CECA Loop will need to be addressed in future studies. Specifically:

- To what extent do players effectively execute the original game plan?
- How well is the information relayed back to the coach, and what factors contribute to its effectiveness?
- How proficiently can coaches compare the ideal game plan with the actual performance on the field?

- Drawing insights from collected information, what specific adjustments can be identified and implemented to enhance effectiveness on the pitch?

The key to answering these future research questions relies on utilizing the LPP to determine how information is both communicated and received by the players. Their temperaments may provide insight into how gameplan information is both received and implemented by the players (essentially- how effective is the directed telescope). The next study should shift from purposeful practice towards in-game assessment of players. Use the GPAI, the coach can assess their "actual" gameplan implementation towards the ideal. This real time data can be compared with a player's temperament to determine if a communication breakdown has occurred and how it can be alleviated in the future. This simple adjustment may be the key to increasing effective communication between the field players and their coaches, which will allow coaches to make more informed adjustments to maximize performance.

5. Conclusion

Effective coaching involves a comprehensive strategy that includes clear objectives, real-game scenarios, and a supportive team environment. The study reveals that effective coaching significantly benefits from a constraint-based approach to training. By modifying existing drills to include specific constraints, coaches can greatly improve players' teamwork, passing, ball control, trapping, and dribbling skills. Coaches can accelerate player performance by implementing a constraint-based approach to their practices. This approach allows coaching staffs to modify their existing practice regimens to accelerate their players' techniques. This study concludes that a constraint-based approach, regardless of a player's temperament, can increase their skills with minimal environmental interventions. The next phase of this longitudinal study will shift the focus from constraint-based practice modifications to testing how temperaments influence in-game communication.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflicts of interest.

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