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Motivating Students With Dyslexia: The Debilitating Effects of Normative Performance Goals on Their Physiological Arousal

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The present study tested the hypothesis that normative vs. non-normative performance goals would be associated with significantly divergent pathways in relation to both cognitive and emotional regulation. Participants were 16 college students with a diagnosis of dyslexia. Students were subjected to an experimental induction of normative and non-normative performance goals while engaged in reading pseudowords. Students' EEG activation, EMG, and BVP were assessed during baseline, relaxation, and experimental conditions. Results indicated that the normative goal condition was associated with lower amplitudes in alpha and beta waves, suggesting the presence of a slow cortical disorder. Furthermore, EMG and HR variability were at higher levels during the normative goal condition, suggesting elevated levels of anxiety and stress. It is concluded that normative performance goals are associated with divergent regulatory mechanisms compared to non-normative performance goals, which are quite stressful for individuals with dyslexia.

Keywords: normative goals, EEG activation, EMG dyslexia, goal orientation, adult learning

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INTRODUCTION

Percentages of students with dyslexia went from 2% in early 1970 (Powell, 1994) to 10% in 2015 (Tasman et al., 2015). The prevalence of reading and writing-related difficulties are potentially enhanced given that attention deficit and hyperactivity disorder (ADHD) is also present (comorbidity rate of 45.1%, DuPaul et al., 2012). Moreover, the male to female ratio is approximately 5:1 (Qasim, 2018). Although dyslexia is diagnosed primarily using psychometric measures that test whether individuals fall at the extreme lower tail of the distribution in reading, writing, and/or phonological awareness (Hitschcock et al., 2004), several studies have shown that students with learning problems have difficulties maintaining proper levels of motivation to stay with a task, which is particularly more important to them compared to the rest of the students (Cano et al., 2021). The latter (motivation) is excluded from any definition of LD although an important proxy, extended time, has proved to be beneficial as a testing accommodation in LD (Ofiesh, 2000; Ofiesh and Hughes, 2002; Lewandowski et al., 2007, 2013; Gregg and Nelson, 2010). However, typical academic practices rarely emphasize active engagement or the provision of additional time for practice for these students. An example is the popular "spelling bee" game where students participate and engage as long as they provide correct responses. Thus, the opportunity to practice is essentially non-existent for students with dyslexia who likely misspell a word during the first round. Moreover, practices (public posting of grades, etc.) are likely associated with students with LD diminished motivation (Butler, 1988; Chamberlin et al., 2018; Koenka et al., 2021), disrespect, ridicule, isolation, teasing, bullying, stigma, and contempt (Smith and Strick, 1997; MacMaster et al., 2002; Colwell and O'Conner, 2003; Kroese and Reed, 2005; Singer, 2005; Gates and Edwards, 2007; Roffman, 2007; Baumeister et al., 2008; Zhao and Zhang, 2008). Low motivation, negative affect, and low academic achievement, coupled with labeling and exclusion due to being identified as disabled (Jenkins et al., 1994) are likely responsible for the extremely high rates of dropout as approximately 38% of them eventually quit school (Calhoon, 2005; Reed, 2005). Their school drop-out rates partly reflect their lack of motivation to continue being engaged that are not at all rewarding; they are punished throughout the day as typical teacher practices find students with LD to be bystanders of the learning that takes place beside them. Motivation and goal-directed behaviors are essential for all students as they are associated with increases in time on task and enhance academic achievement when they are adaptive (e.g., intrinsically based) (Elliot and Thrash, 2002), and the opposite is also true when engaging in maladaptive thought processes (e.g., goal to avoid failure) (Elliot and Church, 1997). The present study engages a revision of the achievement goal theory framework (Grant and Dweck, 2003) to examine goal-directed behaviors and affect in students with dyslexia.

Goal orientations have historically been mentioned in the works of various theorists such as Ames (1984); Nicholls (1984), and Dweck (1986), among others. These goal representations characterize thought processes that are linked to goal-directed behaviors and describe the reasoning behind student engagement with a task (Ames and Archer, 1988). Typically, these motivations can be intrinsic (e.g., identifying with, finding value, or enjoying a task) or extrinsic (expecting positive external outcomes from that engagement). Dweck and Leggett's (1988) conceptualization involved mastery and performance goals. Mastery goals derive from intrinsic interest and joy (Harackiewicz et al., 2000) whereas performance goals are oriented towards validating one's ability (Elliot and Harackiewicz, 1996; Hulleman et al., 2010). Based on a more recent conceptualization by Grant and Dweck (2003) who favored a dichotomization of performance goals based on normative evaluating criteria, "wanting to outperform other students" and "wanting to get a 100% score" are both different manifestations of performance goals. Their thesis for this bifurcation was that the difference in focus may be responsible for a host of different experiential outcomes and divergent academic results. In particular, they hypothesized that the focus on outperforming others may cause unnecessary stress to the person and may restrict cognitive and emotional resources that, although necessary for the task at hand, they are drifted away as a means to cope with the emotional experience (i.e., negative emotions). In their original study, Grant and Dweck found support for this dichotomization as their factor analytic model showed that normative goals were distinct from other types of performance goals such as outcome and ability (second study). In this study, they also failed to find reliable predictions of normative goals with negative processes such as loss of motivation, and withdrawal of effort (fourth study), although they reported a significant positive prediction of denial from normative goals. Sideridis (2008) provided further evidence for this normative and non-normative goals distinction, reporting inferior performance on a cognitive task in the non-normative goal group (compared to the normative goal group). He also reported the potential cognitive interference when participants had to make affect-related associations. However, this differentiation was not supported in the performance of individuals on an easy matching task.

Moreover, evidence from Electroencephalographic studies (EEG) for students with learning disabilities and/or dyslexia that examine motivation and effect on academic tasks is limited, although some evidence for children with Attention Deficit Disorder (ADD) and Attention Deficit Hyperactivity Disorder (ADHD) has indicated functioning in lower frequencies such as theta or delta waves compared to age and gender-matched comparison groups (e.g., Barry et al., 2003; Hobbs et al., 2007). Although the above findings refer to students with ADD and ADHD, findings may apply to students with LD as there is comorbidity between the two disorders of approximately 45% (DuPaul et al., 2012). An interesting question is whether the activation of specific neurocortical pathways is influenced by the goals that likely direct specific academic behaviors.

It is important to evaluate the presence of the above dichotomization because performance goals are at the core of everyday living. Individuals are mainly judged based on favorable criticisms compared to others. Thus, the investigation of the motivation, that is, the outcome of pleasing others, is important to understand as it is likely associated with specific self-regulation and emotional regulation mechanisms. In this study, it is posited that the suggested dichotomization of normative vs. non-normative performance goals would manifest itself using different activation pathways as a function of the diverse emotional reactions experienced during performance pursuits. Specifically, we hypothesize that the emotional burden associated with conforming to normative evaluative standards will devastate individuals with dyslexia since normative comparisons have been consistently reported as undermining their perceived self-worth during school years. The following hypothesis was tested: Individuals in the normative performance goal condition will experience elevated tension and stress as evidenced using enhanced Electromyographic (EMG) activation of the face muscles and elevated Blood Volume Pulse (BVP). Furthermore, they will exhibit EEG activity that occupies low frequencies, which are not conducive to being alert and to performing cognitive and academically complex tasks such as reading.

MATERIALS AND METHODS

Experimental Research Design

Two experimental motivational conditions were induced: (a) a performance approach normative, and (b) a performance approach non-normative. Using a within-person design all participants alternated conditions using a Latin Square randomization schedule. Between any two experimental conditions, a brief relaxation session was introduced as a return to the baseline condition. The duration of the reading task was 1 min followed by a 1-min relaxation interval. The experimental manipulations for the performance-normative goal condition were the following: "With this exercise, we would like to see how people your age read pseudowords. You should try to outperform everybody else in this task." Every 10 s participants received the following prompt: "Try to outperform everybody else" and/or "Try to be the best among all other participants." Directions for the performance non-normative goal condition were as follows: "With this exercise, we would like to see how people your age read pseudowords. I want you to try and do as best as you can." Every 10 s participants received the following prompt: "Try to do as well as you can" with no mention of normative comparisons.

Participants and Procedures

The sample consisted of sixteen adult public university students with a confirmed diagnosis of dyslexia. The students were recruited *via* advertisements on public university boards and English as a Foreign Language (EFL) schools from a large metropolitan area. Participants were between 18 and 54 years (M_{age} = 24 years). There were 10 females and 6 males. Thirteen of them were current university students in various disciplines (e.g., education, mathematics, physics).

The participants came into the psychology lab of a major university and were debriefed about the goals and objectives of the study in general and in vague terms so that not to alter the participants' motivation. That is, they were informed that the objective was to evaluate motivational processes in individuals with a diagnosis of dyslexia while reading. Following the interview, participants signed informed consent and were assured of the confidentiality of the findings. The study's protocol followed closely the ethical principles for research involving human subjects from the Declaration of Helsinki (World Medical Association, 2001). EEG sensors were placed on the Cz location using a cap. Blood volume pulse was assessed using a BVP sensor placed on the finger. Two additional sensors were placed on the forehand to assess EMG artifact activation.

Measures

Pseudoword Decoding

The primary outcome variable was the ability to read out loud pseudowords for 1 min from a given list containing 40 words. Examples of words were "fisampiri," and "ampralia," which were literally meaningless.

Cognitive Processing

It was assessed using (a) the time in seconds required to conduct the correct matching using a computerized Stroop task and (b) the number of errors emitted between conditions.

Electroencephalographic Activity

Cortical activation was assessed using an EEG analysis with sensors placed at the Cz location and the forehand. From the raw signal, theta, alpha, sensorimotor rhythm (SMR), and beta brain waves were recorded and corrected for artifacts. Furthermore, EMG artifact activation was also monitored. Of interest were the examination of activation in areas that involve deeper states such as those reflected in sleep (e.g., delta, theta) as well as the functioning in beta waveforms that reflect adaptive functioning in cognitive tasks. Assessments involved a 4-channel Nexus device.

Data Analysis

Data were analyzed using interrupted time series analysis and a two-step approach. First, a time series model was fit to the data so that the mean squared error would be minimized and the patterns of observed relationships would be best described by an autoregressive or moving average model. This process was done independently for each person and separately for each dependent variable. After fitting the best model to the data, a step function was introduced to compare the two experimental conditions on the entire series. The models tested were in the family of autoregressive and moving average models and combinations of the two (ARIMA). A brief description follows. A moving average process in the order of 1 indicates that the behavior at a given time reflects the average of its disturbance term and some form of the previous disturbance$_{t-1}$. Therefore, Behavior at time-t = Disturbance-$_t$ − θ*B (Disturbance-$_t$).

This suggests that the behavior at time t equals the error associated with time t minus θ times the back shifted error. A moving average process is characterized by autocorrelation functions that decay sharply as the time lag increases. An autoregressive process attempts to explain the correlation between consecutive points using the equation:

$$X_t = \xi + \Phi_1 * X_{(t-1)} + \Phi_2 * X_{(t-2)} + \Phi_3 * X_{(t-3)} + \Phi_\nu * X_{(t-\nu)} + ... + \varepsilon \quad (1)$$

with ξ being the model's intercept, Φ_1, Φ_2, Φ_3, Φ_ν the autoregressive model parameters, and ε being the model's error term (Box and Jenkins, 1976; Montgomery et al., 1990). Thus, the biggest challenge of time series analysis is to identify the least number of autoregressive (p) and moving average (q) parameters that when modeled, provide the best fit to the data (i.e., identify the most parsimonious model).

RESULTS

Comparisons Between Performance-Normative and Non-normative Goals

An interrupted time series analysis was utilized by first fitting the most appropriate model for a given process in that the selected model minimized mean square errors. Subsequent differences in the time series were tested against a step function that defined the experimental manipulation. The coefficients, amounts of explained variance, and type of estimate for each dependent variable are shown in **Table 1** and **Figures 1**, **2**. Results from the analyses indicated that, compared to the non-normative goal condition, participants in the normative goal condition had heightened EMG activity (b_{EMG} = 3.973, $p < 0.05$, see **Figure 1**) and heart rate variability (b_{HRV} = 0.502, $p < 0.001$)

TABLE 1 | Physiological effects of normative and non-normative performance goals on EMG, BVP, EEG, and HRV measures based on ARIMA models.

Parameter	Unstandardized coefficient	S.E.	*T*-value	R^2	ARIMA model
		EMG		96.5%	(2,1,3)
Lag-1 estimate	−0.290	0.022	−13.300***		
Normative slope	3.973	0.991	4.009***		
		BVP amplitude		92.1%	(0,1,12)
Lag-1 estimate	0.145	0.021	6.747***		
Normative slope	0.374	0.084	4.483***		
		Alpha amplitude		36.8%	(0,1,2)
Lag-1 estimate	0.722	0.022	33.358***		
Normative slope	−0.099	0.039	−2.538*		
		Beta amplitude		20%	(0,1,2)
Lag-1 estimate	0.732	0.022	33.851***		
Normative slope	−0.083	0.039	−2.116*		
		SMR		19%	(0,1,2)
Lag-1 estimate	0.749	0.022	34.597***		
Normative slope	−0.093	0.040	−2.346*		
		Low range HRV		92.6%	(0,1,12)
Lag-1 estimate	0.182	0.022	8.413***		
Normative slope	0.502	0.106	4.738***		

Comparisons are based on a dummy variable that defines group membership. EMG, Electromyogram; BVP, Blood Volume Pulse; Alpha Amplitude, Amplitude of Alpha Wave; Beta Amplitude, Amplitude of Beta Wave; SMR Amplitude, Amplitude of Sensorimotor Rhythm; HR, Heart Rate Variability. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

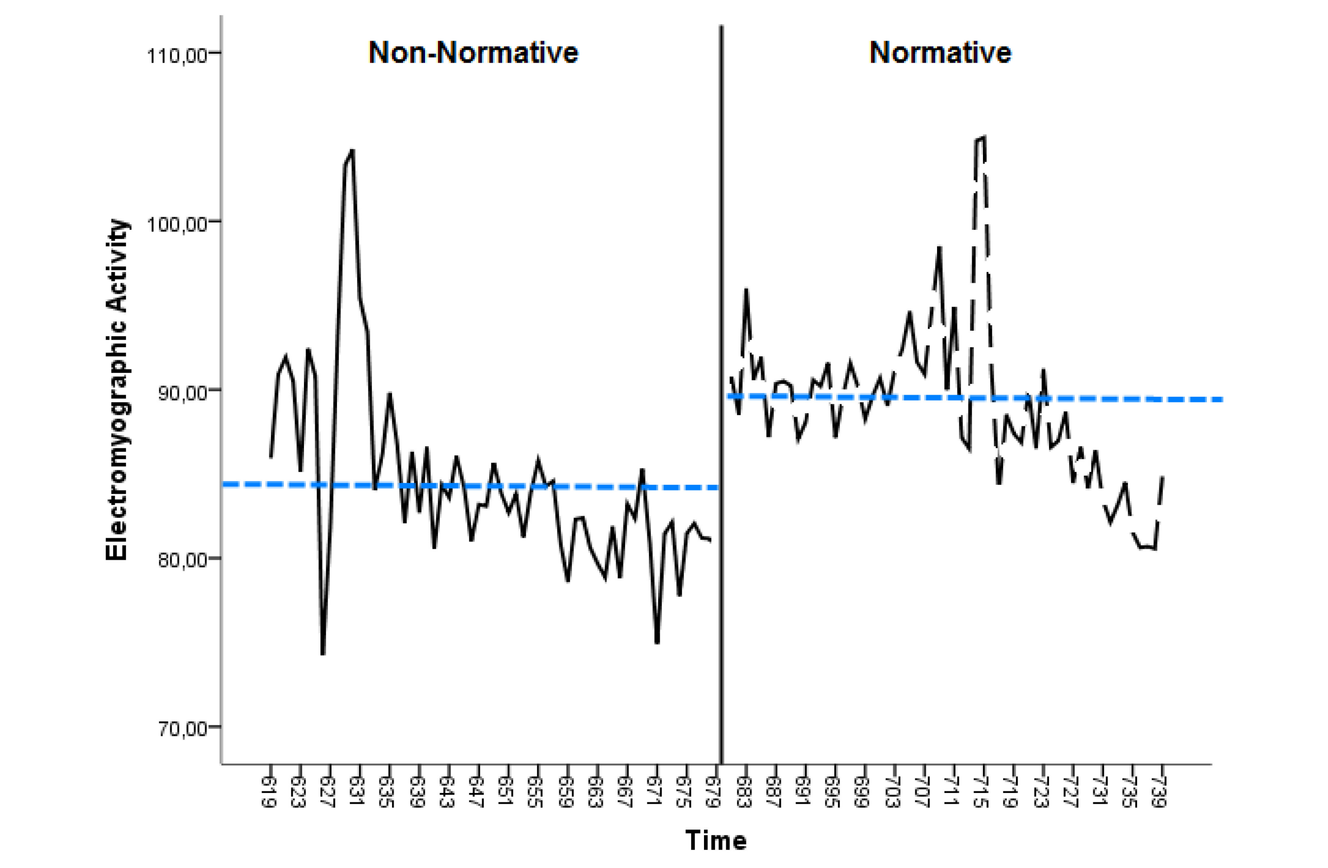

FIGURE 1 | EMG analysis for a participating student in the normative vs. non-normative performance goal condition.

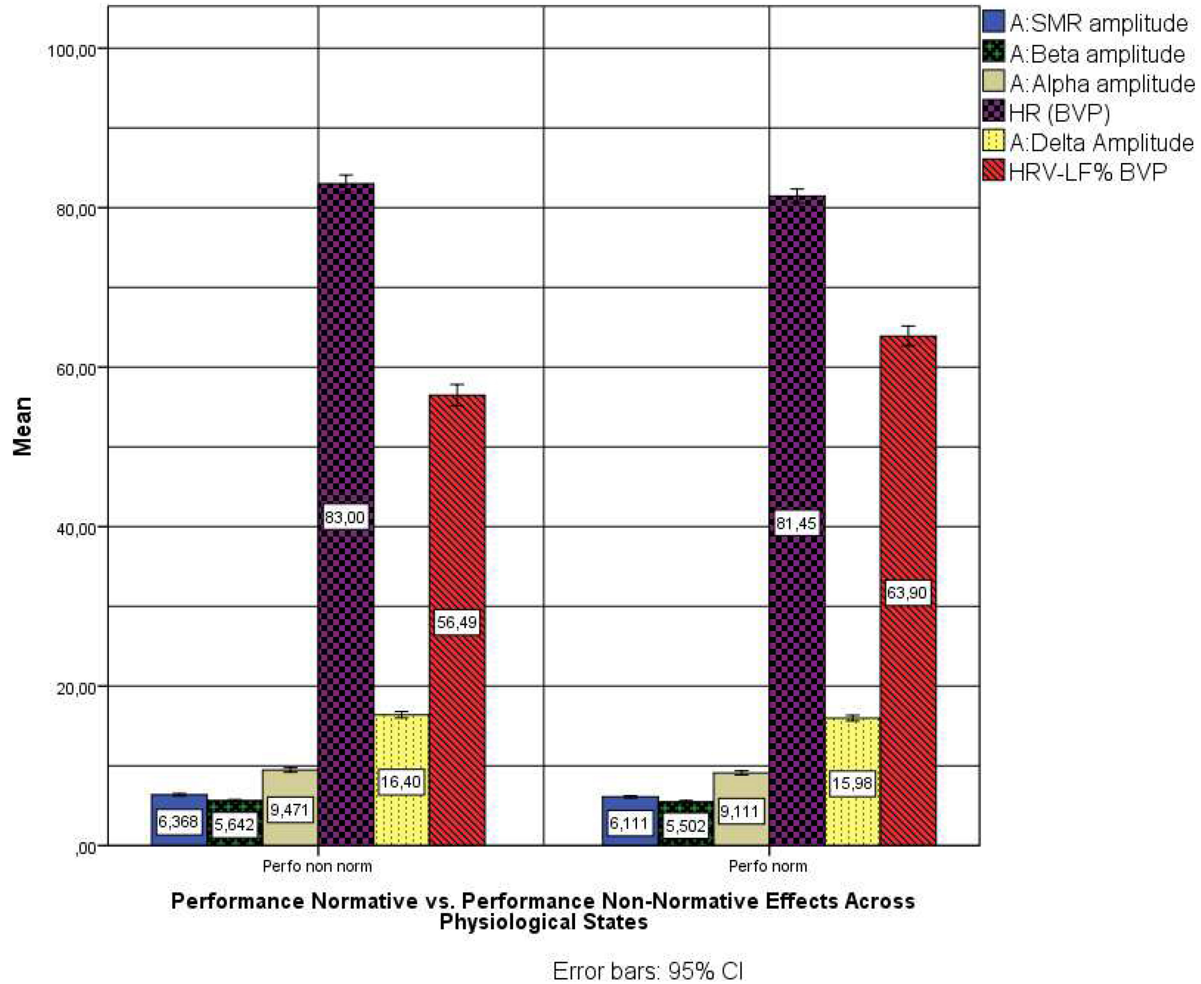

FIGURE 2 | Significant differences between normative performance and non-normative performance goals across all EEG measures.

both suggestive of heightened arousal. Similarly, there were lower levels of alpha wave activation suggesting the presence of slow alpha activity ($b_{ALPHA} = -0.099$, $p < 0.05$), lower beta wave activation ($b_{BETA} = -0.083$, $p < 0.05$), and lower SMR activity ($b_{SMR} = -0.093$, $p < 0.05$). An exception to the predictions was the heightened BVP activity, which is suggestive of vasodilation ($b_{BVP} = 0.374$, $p < 0.05$) rather than vasoconstriction. These coefficients reflect the average change in a process from the performance non-normative condition to the normative one (see **Figure 2**).

Comparisons Between Performance Normative and Non-normative Conditions in Reading Achievement

With regard to the difference in reading pseudowords a paired samples t-test was employed, adjusting for unequal variances, when necessary, as it is found to be robust to violations from normality (Montgomery, 2019). Results suggested that, although the participants read more words in the non-normative goal condition, that difference did not exceed the pre-specified alpha level [$t(10) = 0.976$, $p = 0.35$]. Thus, the main differences between goal conditions were in physiology rather than in reading achievement.

DISCUSSION

The present study sought to test whether normative compared to non-normative performance goals would be associated with divergent pathways. In particular the present study's interest was in the regulation of emotions and cognition related to an academic task, specifically for students with dyslexia for whom academic achievement represents a major challenge. The thesis that normative goals would be linked to elevated and maladaptive physiological responses is grounded on the fact that normative goals have strong social evaluative criteria. These social evaluative comparisons are especially central in academic life as social comparisons may divert one's attention to the self rather than to the task at hand, thus, leading to impaired cognitive performance. Several experimental studies using the original conceptualization of performance goals with an emphasis on normative evaluations have highlighted the harmful effects of these goals on cognitive performance through manipulating evaluative pressures in highly demanding tasks (Baumeister, 1984; Beilock and Carr, 2001, 2005; Beilock et al., 2004; DeCaro et al., 2010). Based on the work of Grouzevialle and Butera (2013) the presence of normative evaluative criteria creates a "dual-task situation" where evaluative pressure inhibits cognitive performance by driving attention away from task-relevant processes to distractive thoughts and irrelevant material [see also Cowan (2001) and Pulfrey et al. (2011)]. Grouzevialle and Butera (2013) termed this phenomenon the "distraction hypothesis" with deteriorated performance being attributed to the depletion of cognitive resources such as working memory. The present study's results partly corroborate these previous studies' findings.

In particular, findings from this study support the distraction hypothesis (Grouzevialle and Butera, 2013). Participants in the normative goal condition allocated resources to irrelevant tasks (elevated myographic activity) and maladaptive EEG activity for the reading task at hand. Thus, the hypothesis that normative goals place unnecessary pressure on individuals and overload the cognitive system is supported by the present physiological analysis. Further evidence on the difference between normative and non-normative goals has been put forth by the work of Darnon et al. (2007) who suggested that as individuals' self-evaluations deteriorate when challenged, the notion of uncertainty becomes particularly prevalent. That is, individuals, become more uncertain about the possibility that enhanced effort will lead to positive outcomes; instead, threats to self-esteem become more prevalent as individuals strive to avoid negative judgments from a potential upcoming failure (Hoffman-Lambird and Mann, 2006). This is why Pulfrey et al. (2011) suggested that normative evaluative criteria likely trigger performance-avoidance goals as they evoke perceptions of lack of control and powerlessness. This disengagement and effort withdrawal may be manifested with EEG activation that resembles the "slow-wave disorder" described by Lubar (1991) in individuals with attention deficit disorder (ADD) [see also Clarke et al. (2011)]. In the present study, during the normative goal condition, participants operated on alpha frequencies of 8–10 Hz, suggesting that the individuals moved towards deeper states such as those involved in sleep and drowsiness. The observed sensorimotor rhythm (SMR) activity of the participants (also termed low beta and reflecting an internal orientation and an idle motor circuit) is considered adaptive for academic purposes. In the present study, SMR activity was lower during the normative performance condition, suggesting an inhabitation of that activity. Furthermore, Beta activity, which is associated with high focus, analytical thinking, and relaxed thinking, was significantly lower in the normative performance goal condition compared to the non-normative goal condition.

Although the physiological responses substantiated the need to distinguish between normative and non-normative performance goals, interestingly, there were no differences between goal conditions on reading pseudowords. This finding may be attributed to the overall low performance of individuals with dyslexia on this task. That is, the performance was almost at floor levels for most participants who struggled to even read five words in a minute. Thus, the limited variance associated with the outcome variable may be responsible for this observation. Certainly, future studies need to repeat these tests and validate or not the present findings.

Collectively, the above findings suggest that the desire to reach goals that are grounded on normative evaluative standards may lead to cognitive and emotional self-regulation failure when these goals are not met. This finding is particularly more problematic for individuals with dyslexia because meeting normative criteria for individuals who typically score below the norm by approximately 1.5–2.0 standard deviations is practically impossible. Alarming is the finding of Pryor and Crossouard (2010) who showed that student ratings to achieve, and thrive have been consistently rising with time, and thus, the gap between students with and without dyslexia may further deepen.

Although important, findings from the present study should be replicated with larger samples, enhanced physiological protocols, self-reported or physiological measures of affect (e.g., rating scales and cortisol analyses), and the presence of controls. Nevertheless, the present study provides preliminary empirical evidence on the distinction between normative and non-normative performance goals regarding self-regulation.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the National and Kapodistrain University of Athens. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

GA developed the literature, designed the methodology, did the analysis, reported the results and discussed them, and approved the submitted version.

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