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Why are they late? Timing abilities and executive control among students with learning disabilities

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ABSTRACT

While a deficient ability to perform daily tasks on time has been reported among students with learning disabilities (LD), the underlying mechanism behind their 'being late' is still unclear. This study aimed to evaluate the organization in time, time estimation abilities, actual performance time pertaining to specific daily activities, as well as the executive functions of students with LD in comparison to those of controls, and to assess the relationships between these domains among each group. The participants were 27 students with LD, aged 20–30, and 32 gender and age-matched controls who completed the Time Organization and Participation Scale (TOPS) and the Behavioral Rating Inventory of Executive Function-Adult version (BRIEF-A). In addition, their ability to estimate the time needed to complete the task of preparing a cup of coffee as well as their actual performance time were evaluated. The results indicated that in comparison to controls, students with LD showed significantly inferior organization in time (TOPS) and executive function abilities (BRIEF-A). Furthermore, their time estimation abilities were significantly inferior and they required significantly more time to prepare a cup of coffee. Regression analysis identified the variables that predicted organization in time and task performance time among each group. The significance of the results for both theoretical and clinical implications are discussed.

What this paper adds?

This study examines the underlying mechanism of the phenomena of being late among students with LD. Following a recent call for using ecologically valid assessments, the functional daily ability of students with LD to prepare a cup of coffee and to organize time were investigated. Furthermore, their time estimation and executive control abilities were examined as a possible underlying mechanism for their lateness. Although previous studies have indicated executive control deficits among students with LD, to our knowledge, this is the first analysis of the relationships between their executive control and time estimation deficits and their influence upon their daily function and organization in time abilities. Our findings demonstrate that students with LD

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need more time in order to execute simple daily activities, such as preparing a cup of coffee. Deficient working memory, retrospective time estimation ability and inhibition predicted their performance time and organization in time abilities. Therefore, this paper sheds light on the mechanism behind daily performance in time among students with LD and emphasizes the need for future development of focused intervention programs to meet their unique needs.

1. Introduction

The term learning disabilities (LD) refers to a wide group of neurological disorders caused by deficits in the central nervous system, which influence the individual's ability to maintain, process or convey information to others in an efficient way (Kavale & Forness, 2000). While the definition of LD varies around the world, most definitions focus on the academic domain (Scanlon, 2013), despite lack of knowledge about the implications of LD and comorbid phenomena (ADHD, DCD) for daily function and behavior in home, work and social environments (e.g., Johnson, Mellard, & Byrd, 2005; Sharfi & Rosenblum, 2014). The literature about students with LD is scarce, despite their increasing number in higher education settings (Heiman & Precel, 2003; Sparks & Lovett, 2009), which has reached approximately 5.7% of students in the United States (National Center for Education Statistics, 2009). In 2008, a law outlining the rights of post-secondary students with learning disabilities was approved in Israel. According to this law, learning disabilities in higher education institutions should be diagnosed by an authority, such as the Council of Higher Education (Law on rights of students with learning disabilities at post-secondary school institutions, 2008). It is approximated that 10–15% of the student population in Israel has been diagnosed with a learning disability (Law proposal on rights of students with learning disabilities at post-secondary school institutions, 2007). According to the Israeli Central Bureau of Statistics, in 2015 there were 264,552 post-secondary students in Israel (Central Bureau of Statistics, 2015). Yet, despite their high number, little is known about students with LD (Gropper, Gotlieb, Kronitz, & Tannock, 2014; Sparks & Lovett, 2009) and their participation in daily activities (Sharfi & Rosenblum, 2014a). Cognitive deficits experienced by those students are also inadequately understood (Gropper et al., 2014) and research about the relationships between their cognitive deficits and actual daily behavior is limited. The available literature on this population indicates that adults with LD deal with difficulties in the performance of daily activities such as baking, driving, using public transportation and participating in leisure activities (Sharfi & Rosenblum, 2014b). In addition, the research shows that students with ADHD require more time to complete everyday activities (Prevatt, Proctor, Baker, Garrett, & Yelland, 2011), and that those with LD also experience difficulties managing and organizing their daily schedule (Guare, Dawson, & guare, 2013; Dahan, Hadas-Lidor, Meltzar, & Roitman, 2008).

Managing a daily schedule requires organization of the tasks that need to be done within a time frame for efficient daily tasks performance (Lavoie, 2006; Rosenblum, 2012). Students with LD and ADHD have emphasized their difficulties in organization and time efficiency (Dahan et al., 2008), as well as their willingness to improve their organization and time management skills (Gropper et al., 2014). Poor time organization among students with LD or ADHD may affect their daily function, and manifest as late arrival to classes, difficulty adhering to time limits and deadlines, and postponing of tasks (Dahan et al., 2008; Guare et al., 2013). However, the literature on the ability of students with LD to organize and manage their daily tasks in time is limited, thus, more research is required to understand the underlying mechanisms (Rosenblum, 2012).

Time estimation, defined as the individual's ability to accurately perceive the duration of a temporal interval (Zakay, 1990), is required for the efficient organization of time (Rosenblum, 2012). Time estimation ability is generally evaluated by timing tasks that require retrospective or prospective responses (Bauermeister, Barkley, Martínez, Cumba, Ramírez, & Reina, 2005), while the participant estimates the duration of an interval, either knowing it in advance (prospective) or not (retrospective) (Hurkes & Hendriksen, 2011; Prevatt et al., 2011). Time estimation is an important ability for students' optimal daily performance, enabling them to estimate the time it will take to arrive to class on time, manage their schedule to allow sufficient time for studying, and start a project or homework assignment on time (Hurkes & Hendriksen, 2011; Prevatt et al., 2011). Despite its importance, there is a lack of research on time estimation abilities among people with LD (e.g., Willburger, & Landerl, 2010). In addition, though time estimation deficiency has been identified among individuals with ADHD (e.g., Pollak, Kroyzer, Yakir, & Friedler, 2009; Prevatt et al., 2011), most studies in this area have been performed in a laboratory setting and do not relate to real life daily tasks (Prevatt et al., 2011).

Time estimation is an executive ability (Barkley, 1997; Brown, 2009; Ustun, 2007), which enables the individual to execute certain activities while taking into account the given amount of time. Executive functions (EF) are higher-level cognitive functions which include complex goal-directed behaviors (WHO, 2007). They are composed of two close but separate executive abilities: meta-cognitive ability and motivational-emotional ability (Ardila, 2008; Dawson & Guare, 2004; Roth et al., 2005). According to the literature, individuals with LD have impaired executive abilities (e.g., Compton, Fuchs, Fuchs, Lambert, & Hamlett, 2012; Horowitz-Kraus, 2014; Varvara, Varuzza, Sorrentino, Vicari, & Menghini, 2014). In particular, college students with LD, ADHD and DCD struggle with executive difficulties in planning, inhibition, working memory, time organization and management (Brosnan, Demetre, Hamill, Robson, Shepherd, & Cody, 2002; Dahan et al., 2008; Fleming &

Table 1
Demographic characteristics of participants in the research and control groups.

Demographic characteristics	Values	Students with LD (n = 27)		Controls (n = 32)		X^2
		Frequency	Percentage	Frequency	Percentage	
Gender	Male	5	18.5%	7	21.9%	0.7
	Female	22	81.5%	25	78.1%	5
Familial status	Single	18	66.7%	16	50%	0.2
	Couple	6	22.2%	14	43.8%	1
	Married	3	11.1%	2	6.2%	
Number of years of education	First	8	29.6%	8	29.6%	0.9
	Second	8	29.6%	10	37%	2
	Third	8	29.6%	6	22.2%	
	Fourth	3	11.1%	3	11.1%	
Area of study	Teaching	5	19.2%	3	9.4%	0.7
	Medicine	4	15.4%	4	12.5%	4
	Exact science	2	7.7%	4	12.5%	
	Social sciences	10	38.5%	16	50%	
	Other	5	19.2%	5	15.6%	
Employment status	Employed	18	66.7%	22	68.8%	0.8
	Unemployed	9	33.3%	10	31.2%	6

$p < 0.001^{***}$.

McMahon, 2012; Kirby, Edwards, Sugden, & Rosenblum, 2010; Trainin & Swanson, 2005). Though EF abilities are crucial for daily function (Chan, 2001; Katz & Maeir, 2011; Weiner, Toglia, & Berg, 2012), the literature about the implications of EF deficits on the daily performance of individuals with LD, including time performance and organization of activities within a given frame time, is scarce.

Time organization, time estimation and EF are central tools for everyday life (e.g., Hurkes, & Hendriksen, 2011; Katz & Maeir, 2011; Pollak et al., 2009; Rosenblum, 2012; Weiner et al., 2012), especially for students, for whom tasks are numerous, expectations are high, and time is limited (Rosenblum, 2012). Nevertheless, the literature about the relationships between actual performance time of certain daily activities, organization in time with EF and time estimation abilities is limited. Owen and Wilson (2006) emphasized that the implications of a deficit in time understanding in daily living for people with LD is not clear. Therefore, there is a need to more extensively examine the existence of time estimation and EF deficits among students with LD, with a focus on the possible relationships between those deficits and students' daily performance. Performance in "ecologically valid" real world tasks may show closer concordance with observed symptoms in everyday life than performance in traditional experimental lab setting derived tasks (Burgess, Alderman, Evans, Emslie, & Wilson, 1998).

Thus, the goal of the present study was to compare the organization in time, time estimation, actual performance time of daily activities and EF abilities of students with LD to those of matched controls without LD, using "ecologically valid" assessments. Furthermore, the study aimed to assess whether time estimation and/or EF predicts the time performance of daily activities, and if time estimation and/or EF and/or time performance predict the ability to organize time. The hypotheses were as follows: (1) Significant differences will be found between students with and without LD regarding organization in time, prospective and retrospective time estimation, actual performance time and EF (2) Time estimation and EF will predict the actual performance time of certain daily activities, while time estimation, EF and actual performance time of certain activities will predict daily time organization abilities in each group (LD versus controls).

2. Methods

2.1. Participants

The sample included 59 students, aged 20–30 years, who were born and studied in universities and colleges in Israel. From the entire sample, 27 were diagnosed with a learning disability by an authority, such as the council of higher education, and 32 were matched controls. As the current paper focuses on identifying the mechanism behind daily performance in time among students with LD rather than examining specific LD types, every student who had any kind of learning disability was included in the study. Among the LD group, 21 were diagnosed with dyslexia, ten with dysgraphia, and eight with dyscalculia. Seven had at least two learning disability diagnoses (such as dyslexia and dysgraphia) and seven were diagnosed with a learning disability and ADHD. The participants studied at 12 different universities and colleges in Israel.

No significant difference was found in the participants' mean age between the groups (LD: M = 25.42 SD = 25.42 controls: M = 24.66 SD = 2.61). The participants' demographic characteristics are presented in Table 1. No significant group differences were found for gender, employment status, residential environment, familial status, or years of education. The majority of participants in both groups were female. However, significant differences between the groups were found for work hours. A considerable percentage of the control students (41.66%) worked more than 20 h a week in comparison to none in the LD group.

2.2. Instruments

The author-designed, demographic questionnaire was used to collect background data on the participants.

Organization in time was assessed with the Time Organization and Participation Scale (TOPS) (Rosenblum, 2012). The TOPS is a self-report scale that assesses the perceived ability of organization of daily life tasks on time, among adults. The questionnaire was written in Hebrew and it's reliability and validity was established for use by adults in Israel (Rosenblum, 2012). It is composed of 34 items within 3 major domains. The first domain (A) relates to daily task performance at an appropriate pace (20 items: 1–20); the second domain (B) relates to the individual's success in organizing a whole day or a certain period of time in a satisfactory manner (5 items: 21–26); and the third domain (C) relates to emotional responses to organization in time abilities (7 items: 26–32). Finally, two items (D1 and D2) relate to the influence of change in routine and various stimuli on the individual's time organization abilities. All of the items are rated on a five-point Likert scale. Participants who had a mean final score of below 3.16 are considered to be at potential risk for difficulties in on-time organization of daily life tasks. The TOPS was found to have good content, face and concurrent validity and acceptable internal consistency. Furthermore, validity was demonstrated by its three domains and by its distinction between age groups in organization of time (Rosenblum, 2012).

Time estimation ability was assessed by the students' capability to accurately estimate the time duration of daily activity performance. As a result of the method reported on by Prevatt et al. (2011), the current research examined prospective and retrospective time estimation as it relates to a common daily task, preparing a cup of coffee. Each student was asked to estimate the task duration before and after the actual performance (pre-performance they were asked: 'How many seconds do you believe it will take you to complete the task?' and after the task performance they were asked: 'Now that you have completed the task, how many seconds do you believe it actually took to complete it'?).

While the activity was performed, the actual activity duration was measured with a computer timer activated by the student at the beginning of the activity. In order to prevent a biased answer, the student wrote their two time estimates on a form before seeing the measured result. The following five variables were utilized as dependent measures: 1. Prospective time estimate 2. Actual performance time 3. Retrospective time estimate 4. Prospective gap score (the absolute gap between the prospective estimation and actual performance time) and 5. Retrospective gap score (the absolute gap between the retrospective estimation and actual performance time). Low prospective/retrospective gaps indicate a strong time estimation ability and vice versa.

Executive function was assessed using the Behavioral Rating Inventory of Executive Function-Adult Version (BRIEF-A) (Roth et al., 2005). The BRIEF-A is an ecologically standardized self-report measure that captures adults' views of their own EFs in their everyday environment. The score is based on the results of 75 equivalently scored statements within nine non-overlapping sections. The Global Executive Composite (GEC) Index represents the overall EF score. The GEC is comprised of two indexes: the Behavioral Regulation Index (BRI) that comprises items for emotional control, shifting, and inhibition scales, and the Metacognition Index (MI) that comprises items for self-monitoring, task monitoring, organization of materials, planning/organization, working memory, and initiation scales. Participants rate the frequency with which the behavior described in each statement occurs. The three optional responses were converted into numbers (1–3), such that three represents high frequency. Raw scores were transformed into T scores for results interpretation. A GEC of 50 represents the average, standard score. A standard score of 65 and above (>1.5 SD) indicates a deficit. Established psychometric properties include internal consistency, inter-rater agreement and test-retest reliability. Discriminant validity has been established for people with ADHD (Roth et al., 2005).

2.3. Procedure

Ethical approval was obtained from the University of Haifa's Ethics Committee. Students with LD were contacted by phone, mail or fliers through support centers at Israeli colleges and universities and use of personal connections. Students who agreed to participate and signed an informed consent received a website link for the purpose of completing demographic, BRIEF–A (Roth et al., 2005) and TOPS (Rosenblum, 2012) questionnaires and the completion of the time estimation task (preparing a cup of coffee). Both the questionnaires and the task were performed anonymously and independently, at the students own time and choice of location, while the main researcher was available by phone for assistance and support, if needed. Controls were recruited from a similar location and matched to the research group by age, gender and socioeconomic status. They signed the consent form and performed the same procedures described above.

2.4. Data analysis

Descriptive statistics were used to describe the sample. The demographic variables of the two groups (control and LD) were compared using chi-square tests. MANOVA and T tests for independent variables were applied in order to analyse the differences in dependent variables between the groups. Stepwise regression analyses were conducted to examine the prediction of both task performance time and organization in time by EF, and time estimation ability in each group (LD versus controls).

Table 2
Group differences for Time Organization and Participation Scale (TOPS) domains.

TOPS Domains	Students with LD (n = 27) M (SD)	Controls (n = 32) M (SD)	F (3,55)	P	η
A	2.54 (.71)	1.98 (.49)	12.81	0.001***	0.18
B	3.25 (.78)	2.30 (.68)	24.77	0.000***	0.30
C	2.77 (.85)	2.32 (.58)	5.60	0.021*	0.09

Note: A = daily task performance at an appropriate pace; B = individual's success in organizing a whole day or a certain period of time in a satisfactory manner; C = emotional responses to organization in time abilities.
* $p < 0.05$.
*** $p < 0.001$.

Table 3
Group differences for prospective and retrospective time estimate (Part A), actual performance time and prospective and retrospective gap scores (Part B).

	Students with LD (n = 27) M (SD)	Controls (n = 32) M (SD)	F (1,57)	P	η
A. Time estimation					
1. Prospective time estimation	215.73 (23.36)	174.69 (17.89)	2.01	NS	
2. Actual performance time	216.08 (115.42)	159.71 (78.17)	4.95	0.03*	0.08
3. Retrospective time estimation	230 (26.01)	173.59 (15.95)	3.65	NS	
B. Gap scores					
4. Prospective gap score	83.30 (63.48)	41.12 (56.94)	7.23	0.009*	0.11
5. Actual performance time	216.08 (115.42)	159.71 (78.17)	4.95	0.03*	0.08
6. Retrospective gap score	84.23 (67.70)	36.45 (35.75)	11.99	0.001***	0.17

Note: Prospective gap score = the absolute gap between the prospective estimation and actual performance time; Retrospective gap score = the absolute gap between the retrospective estimation and actual performance time.
* $p < 0.05$.
*** $p < 0.001$.

3. Results

3.1. Group differences in time organization (TOPS)

MANOVA yielded significant differences between the groups in time organization (Wilks' Lambda = 0.69 F(3,55) = 8.30 p = 0.17 $\eta^2 = 0.08$). As presented in Table 2, ANOVA revealed significant group differences for all three domains of organization in time.

3.2. Group differences in time estimation characteristics of actual performance time of daily tasks

MANOVA testing yielded no significant differences between the groups in prospective time estimation (1), actual performance time (2) and retrospective time estimation (3) (Wilks' Lambda = 0.81 F(3,55) = 79.95 p = 0.17). As presented in Table 3, ANOVA revealed significant group differences for actual performance time (Part A).

MANOVA testing yielded significant differences between the groups in prospective gap score (4), actual performance time (5) and retrospective gap score (6) (Wilks' Lambda = 0.79 F(3,55) = 4.90 p < 0.004 $\eta^2 = 0.21$). As presented in Table 3, part B, ANOVA testing revealed that each of the three measures, including prospective and retrospective gap scores, as well as actual performance time, were significantly higher among students with LD.

3.3. Group differences in executive functions (BRIEF-A)

As presented in Table 4, significant group differences were found regarding GEC scores (t (49.75) = 3.44 p < 0.001); the majority of the LD group scored within the clinically impaired range on GEC scores (55.55%), compared to fewer students in the control group (28.12%). Likewise, the GEC mean scale score of students with LD was clinically impaired (66.07; SD = 11.67), demonstrating the frequency of EF deficits among these students.

Significant group differences were found also in EF, in the MI index (t (45.70) = 4.11, P < 0.001), but not in the BRI index (t (57) = 1.20 p = NS). When examining frequencies according to clinically significant cut-off scores (t > 65), 44.44% and 33.33% of the students with LD struggled with MI and BRI impairments, respectively, compared to 9.37% of the control group.

MANOVA indicated significant group differences in all nine scales of the BRIEF-A. (Wilks' Lambda = 0.58 F(9,49) = 3.8, p < 0.001, $\eta^2 = 0.41$). As presented in Table 4, the LD group achieved higher scores (more deficient EFs) on all scales, compared to the control group, reflecting a notable difference between students with and without LD. However, ANOVA revealed significant group differences in only four MI scales; working memory, planning/organization, task monitoring, and organization of materials. According to clinically significant cut-off scores (t > 65), more than one third (40.74%, 40.74% and 37.03%, respectively) of the students with LD dealt with impairments in the last three abilities, while more than half (62%) had a working memory deficit. Correspondingly, the working memory mean scale score among students with LD was found to be clinically impaired (80.92; SD = 74.05).

Table 4
Group differences for BRIEF–A indexes and scales.

BRIEF-A Indexes/Scales	Students with LD (n = 27) M (SD)	Controls (n = 32) M (SD)	*T (57)*	*p*	
Indexes					
GEC	66.07 (11.67)	56.97 (8.24)	3.44	0.001***	
MI	62.67 (11.67)	51.66 (8.24)	0.42	0.001*** 0.03*	
BRI	59.11 (10.62)	55.66 (11.30)	1.20	NS	
			F (1, 57)	p	η
Scales					
Initiation	57.48 (10.79)	52.94 (8.78)	3.18	NS	
Working Memory	80.92 (74.05)	53.75 (10.47)	4.22	0.04*	0.07
Planning/Organization	59.44 (13.59)	50.15 (8.04)	10.58	0.002**	0.16
Task Monitoring	63.59 (10.72)	52.16 (9.40)	19.06	0.001***	0.25
Organization of Materials	58.89 (14.42)	48.84 (10.03)	9.88	0.003**	0.15
Inhibition	57.67 (11.36)	53.09 (9.18)	2.93	NS	
Shifting	57.30 (11.02)	54.06 (10.21)	1.37	NS	
Emotional Control	59.07 (12.04)	56.28 (10.51)	0.88	NS	
Self-Monitoring	54.52 (11.94)	50.22 (9.60)	2.35	NS	

Note: GEC = Global Executive Composite Index; MI = Metacognition Index; BRI = Behavioral Regulation Index.
* p < 0.05.
** p < 0.01.
*** p < 0.001.

Table 5
Prediction of manner and satisfaction in which activities are organized in time throughout the day (TOPS B) by task performance time, EF domains and time estimation abilities (B), in each study group.

Students with LD						
Variable	Model 2			Model 1		
	β	SE B	B	β	SE B	B
Inhibition (BRIEF-A)	0.041	0.011	0.60**	0.037	0.010	0.53**
Retrospective gap score				0.034	0.002	0.35*
R^2 (Adj.rsq)	36			48		
F change in R^2	14.11**			5.37*		

Controls						
Variable	Model 2			Model 1		
	β	SE B	B	β	SE B	B
Emotional control (BRIEF-A)	0.56	0.59	0.48**	0.026	0.010	0.39**
Inhibition (BRIEF-A)				0.025	0.011	0.34*
R2 (Adj.rsq)	23			34		
F change in R^2	8.99**			4.95*		

Note: Retrospective gap score = the absolute gap between the retrospective estimation and actual performance time.
*p < 0.05 **p < 0.01.

3.4. (A) Prediction of actual performance time of a daily task (coffee preparation) by EF scales and time estimation ability

Stepwise regression analysis performed in each group indicated that among students with LD, working memory accounted for 33% of the variance in actual performance time ($F(1,25) = 12.47$ $p = 0.002$ $\beta = 0.58$). Among controls, retrospective time gap accounted for 22% of the variance of actual performance time ($F(1,30) = 8.40$ $p = 0.007$ $\beta = 0.47$).

3.5. (B) Prediction of the manner and level of satisfaction with time organization of activities throughout the day (TOPS B) by EF, time estimation abilities, and task performance time

As presented in Table 5, the stepwise regression analysis indicated that among students with LD, inhibition and retrospective gap score predicted 48% of the variance of the manner and satisfaction experienced from daily organization ($F(2,24) = 11.02$ $p = 0.034$ $\beta = 0.34$); 34% of the variability of this construct was predicted by inhibition and emotional control among controls ($F(1,30) = 7.54$ $p = 0.028$ $\beta = 0.350$).

4. Discussion

The current study aimed to shed light on the unique performance characteristics of students with LD, investigating the effect of their organization in time of daily life tasks ability, time estimation ability, time performance of daily activity and

EF. The results indicated that students with LD had significant difficulties with organization in time, exhibited significantly lower time estimation ability and required significantly more time for task completion. Furthermore, they showed significantly inferior EF abilities reflected in the final BRIEF score, MI index and specific MI abilities including working memory, planning/organization, task monitoring, and organization of materials.

The findings of the current study show that students with LD struggle with difficulties in time organization of daily life tasks, demonstrating that such students have difficulties in performing daily tasks at an appropriate pace, organizing their day or a certain period of time in a satisfactory manner, and tend to experience more frequent emotional responses following the unsuccessful organization of time. Therefore, these findings reinforce the limited literature that has highlighted the presence of organization difficulties among students with LD (Dahan et al., 2008; Gropper et al., 2014; Guare et al., 2013), and demonstrate how such difficulties affect the daily function, behavior and performance of students with LD.

Findings related to time estimation ability were found to be similar to previous findings among students with ADHD (e.g., Pollak et al., 2009; Prevatt et al., 2011). Students with LD were also found to have prospective and retrospective time estimation deficits related to performance time of daily activities. These findings contrast with the results of studies that used flashlight-type tasks that last a few seconds (e.g.,Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001; Bauermeister et al., 2005) and did not find time estimation deficits among people with ADHD. The current findings emphasized the need for "real world" tasks and assessments of those abilities (Abikoff et al., 2009; Alderman, Forbes, Costello, Coates, Dawson, & Anderson, 2006). By evaluating time estimation using a daily activity such as coffee preparation, the current study demonstrates how the time estimation deficit manifests among even very simple and ordinary daily activities among students.

Time estimation is a component of organization in time (Rosenblum, 2012), as well as executive ability (Barkley, 1997; Brown, 2009; Ustun, 2007). By showing significantly inferior EF abilities reflected in the final BRIEF score and MI index, the study adds to evidence which indicates that people with LD deal with global, central, or multiple EF impairment, but not isolated, specific deficits (e.g., Trainin & Swanson, 2005; Varvara et al., 2014). Nonetheless, the findings that indicate MI but not BRI impairment, enable the identification of and focus on MI abilities as the source of the executive deficit among people with LD. The results show that students with LD also struggle with impairments in specific executive abilities; working memory, planning/organization, task monitoring, and organization of materials. Thus, these findings reinforce the consensus among researchers regarding a specific working memory deficit in individuals with LD (e.g., Beneventi, Tonnessen, Ersland, & Hugdahl, 2010; Compton et al., 2012; De-Weerdt, Desoete, & Roeyers, 2012 Varvara et al., 2014), suggesting a domain working memory problem, which may be associated with central executive processes (Beneventi et al., 2010; De-Weerdt et al., 2012). Chiappe, Hasher & Siegel (2000) explained that working memory impairment may be caused by lower capacity, in addition to inhibition difficulties that influence the ability to restrict and regulate the entry of relevant information to this system. As opposed to well-explored working memory ability, the evidence regarding other executive abilities are inconsistent (Reiter, Tucha, & Lange, 2004) and limited. Therefore, the current study broadens the limited existing body of knowledge, and contributes to research that has found evidence for organizational and planning impairments among children and students with ADHD and DCD (Abikoff et al., 2009; Kirby et al., 2010) and regarding monitoring difficulties among students with LD (Josman & Rosenblum, 2011). In addition, the current study helps identify deficits in specific EF abilities, which may be part of the underlying mechanism behind students' LD performance difficulties.

In order to examine the daily performance of students with LD, actual performance time of the coffee preparation task was compared between the research and control groups. The results showed that students with LD needed significantly more time for task completion, reinforcing the findings of Prevatt et al. (2011) that students with ADHD need more time in order to complete a novel, complex task, similar in nature to everyday activities. Prevatt et al. (2011) hypothesized that despite the students' impulsivity, the complex nature of the task required more effort and concentration from students with ADHD, and that the novel nature of the task and the awareness of being assessed motivated them to exert extra effort to focus on the task. However, in the current research, the task of preparing a cup of coffee, was not novel or complex, rather a simple daily activity. Therefore, it may be that a more basic and extensive reason, such as EF deficit, may be responsible for the longer time required of students with LD, which according to the current study, characterizes EF impairments. The findings of the current study contribute to the scarce evidence regarding participation and activity domains in adults with LD (Sharfi & Rosenblum, 2014a), and emphasize that in addition to performance difficulties in relatively complex daily activities, such as driving and using public transportation (Sharfi & Rosenblum, 2014b), adults with LD also have difficulties executing simple daily activities, such as preparing a cup of coffee.

In addition, the study findings indicate that among students with LD, the actual task performance time was predicted by working memory and among students without LD, by retrospective time estimation. Thus, the findings should be interpreted in the context of Barkley's hybrid neuropsychological model of EF (Barkley, 1997). According to Barkley (1997), working memory is responsible for maintaining information about the past for the formulation both of a plan in the future, and of preparatory behaviors. These behaviors, implemented during the coffee preparation task, such as boiling water at the beginning of the activity while simultaneously performing other components of the task (choosing a mug, adding sugar, etc.), may reduce its time performance, and vice versa. Although working memory is a well-explored ability in people with LD (eg., Locascio et al., 2010; Semrud-Clikeman, 2005), the few researchers that have examined its' influence on daily life have referred only to the implications of working memory deficit on academic life (e.g., Gropper et al., 2014; Henry, 2001). Consequently, the current research also contributes to the limited literature in this area. Although the findings regarding students without LD did not show the prediction of time performance by working memory, they do indicate that it is predicted by the working memory component of retrospective time estimation (Barkley, 1997). Barkley et al. (2001) suggested that

retrospective time estimation may be influenced by the inability to retain information in working memory; the different results may stem from the significant differences between the research group characteristics, among them, the tendency of students with LD towards working memory impairment. As a result, the findings reinforce the Barkley model (1997), emphasizing the important role of working memory and it's components in executing daily goal-directed activities, such as coffee preparation, by students with and without LD.

Following the investigation of the underlying mechanism behind time performance of daily activity, the study examined whether EF, time estimation and time performance of daily activity predicts timely organization of daily activities. The findings indicate that success in timely organization of daily life activities was predicted by inhibition among students with and without LD. Barkley (1997) emphasized that response inhibition provides a delay in the execution of responses and during that delay, self-directed actions could begin to take place so as to evaluate and modify the decision to respond (Barkley, 2001). Therefore, a deficit in inhibition leads to decreased control of goal-directed activities (Barkley, 1997). This explanation helps clarify why the time organization of activities, composed of domains such as the appropriate pace of daily task performance and the extent to which the individual succeeds in organizing a certain period of time in a satisfactory manner, are predicted by inhibition among students both with and without LD. Time organization among students with LD was also found to be predicted by retrospective time estimation ability. Considering the lack of research in this area, these results may be explained by Barkley (1997), who noted that time estimation difficulties may lead to a more deficient organization of behavior relative to time. Regarding students without LD, these findings show that organization in time is also predicted by emotional control. Barkley's model (1997) links between emotional control and the execution of goal-directed activities, by stating that deficiencies in emotional control may manifest as a reduced capacity to induce and regulate the emotional state in the service of goal-directed behavior. Accordingly, emotional impulsiveness among young adults with ADHD has been found to contribute to numerous impairments in occupational, educational, driving, and financial outcomes, beyond ADHD symptoms (Barkley, 2010). The current study also contributes to these findings, showing that emotional control influences goal-directed behavior, by predicting organization of daily activities in time. Furthermore, it demonstrates that the influence of certain EF abilities, such as working memory, retrospective time estimation, inhibition and emotional control, upon the daily performance of students doesn't depend on the existence of ADHD/LD, but is relevant to the general population.

The results of the current study should be interpreted in the context of several limitations. First, students with LD and comorbid neurodevelopmental diagnoses (such as ADHD or DCD) were not excluded from the sample. Thus, specific characteristics of such diagnoses may have influenced the results. Second, the participants in the study were recruited by convenience sample and the inclusion criteria include only a self-report of an LD diagnosis. Therefore, the possibility of generalizing the research findings is limited, and the results may be less accurate. Future studies should use randomized trials and an adult sample divided into sub-groups, according the different neurodevelopmental diagnoses that are comorbid with LD. This classification may enhance the understanding of the variance that characterizes the different expressions of brain dysfunctions. Finally, there is a need to continue investigating the implications of EF deficits, including time estimation, in the daily performance of people with LD, regarding performance time of daily activity and the timely organization of daily activities. Future studies should examine the relationships and influence between time organization, time estimation, actual time performance and EF abilities, regarding additional aspects of performance (such as quality and frequency) and diverse daily activities.

In conclusion, the findings of this preliminary study show that students with LD have difficulties with time organization, exhibit lower time estimation ability and need more time for daily task completion. Furthermore, they struggle with global EF deficit, and difficulties in specific MI abilities such as working memory, planning/organization, monitoring of tasks, and organization of materials. In addition, actual performance time and timely organization of daily activities were predicted by certain EF abilities. These findings contribute to the understanding of the performance characteristics of students with LD, and reveal the underlying mechanism behind the daily performance of students with and without LD, regarding timely activity performance and organization of daily tasks. Moreover, they support the validity of Barkley (1997)Barkleys' model (1997) for the general population and broaden the evidence in the literature about daily performance among students with LD. As a result, they enable a better understanding of LD characteristics and the unique performance challenges of students with LD, while laying the foundation for the development of a future intervention program.

References

Ardila, A. (2008). On the evolutionary origins of executive functions. *Brain and Cognition*, http://dx.doi.org/10.1016/j.bandc.2008.03.003

Abikoff, H., Nissley-Tsiopinis, J., Gallagher, R., Zambenedetti, M., Seyffert, M., Boorady, R., & McCarthy, J. (2009). Effects of MPH-OROS on the organizational, time management, and planning behaviors of children eith ADHD. *American Academy of Child and Adolescent Psychiatry*, *2*, 166–175. http://dx.doi.org/10.1097/CHI.0b013e3181930626

Barkley, R. A., Edwards, G., Laneri, M., Fletcher, K., & Metevia, L. (2001). Executive functioning, temporal discounting, and sense of time in adolescents with attention deficit hyperactivity disorder (ADHD) and oppositional deficit disorder (ODD). *Journal of Abnormal Child Psychology*, *29*, 541–556.

Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin*, *121*, 65–94.

Barkley, R. A. (2001). The executive functions and self-regulation: An evolutionary neuropsychological perspective. *Neuropsychology Review*, *11*, 1–29.

Barkley, R. A. (2010). The unique contribution of emotional impulsiveness to impairment in major life activities in hyperactive children as adults. *Journal of the American Academy of Child & Adolescent Psychiatry*, *49*, 503–513.

Bauermeister, J. J., Barkley, R. A., Martínez, J. V., Cumba, E., Ramírez, R. R., Reina, R., et al. (2005). Time estimation and performance on reproduction tasks in subtypes of children with attention deficit hyperactivity disorder. *Journal of Clinical Child and Adolescent Psychology*, *34*, 151–162.

Beneventi, H., Tonnessen, F., Ersland, L., & Hugdahl, K. (2010). Executive working memory processes in dyslexia: Behavioral and Fmri evidence. *Scandinavian Journal of Psychology*, *51*, 192–202. http://dx.doi.org/10.1111/j.1467-9450.2010.00808.x
Brosnan, M., Demetre, J., Hamill, S., Robson, K., Shepherd, H., & Cody, G. (2002). Executive functioning in adults and children with developmental dyslexia. *Neuropsychologia*, *40*, 2144–2155.
Brown, T. E. (2009). ADD/ADHD and impaired executive function in clinical practice. *Current Psychiatry Reports*, *5*, 407–411. http://dx.doi.org/10.1007/s11920-008-0065-7 (Adobe Digital Editions version)
Burgess, P., Alderman, N., Evans, J., Emslie, H., & Wilson, B. A. (1998). The ecological valisity of tests of executive functions. *Journal of the International Neuropsychological Society*, *4*, 547–558.
Burgess, P., Alderman, N., Forbes, C., Costello, A., Coates, L., Dawson, D. R., et al. (2006). The case for the development and use of ecologically valid measures of executive function in experimental and clinical neuropsychology. *Journal of the International Neuropsychological Society*, *12*, 194–209.
Central Bureau of Statistics. (2015). *Students in universities, academic colleges and colleges of education, by degree*. Jerusalem: Israel Central Bureau of Statistics (In Hebrew). Retrieved http://www.cbs.gov.il/shnaton66/st08_54.pdf
Chan, B. C. K. (2001). Dysexcutive symptoms among a non-clinical sample: A study with the use of the dysexecutive questionnaire. *British Journal of Psychology*, *92*, 551–565.
Chiappe, P., Hasher, L., & Siegel, S. S. (2000). Working memory, inhibitory control and reading disability. *Memory & Cognition*, *28*, 8–17.
Compton, D. L., Fuchs, L. S., Fuchs, D., Lambert, W., & Hamlett, C. (2012). The cognitive and academic profiles of reading and mathematics learning disabilities. *Journal of Learning Disabilities*, *45*, 79–95. http://dx.doi.org/10.1177/0022219410393012
Dahan, O., Hadas Lidor, N., Meltzer, Y., & Roitman, Y. (2008). Organizing recourses and time – from theory to practice, workshop in the framework of the center for supporting students with learning disabilities. *Topics in Special Education and Rehabilitation*, *3*, 59–75 (In Hebrew).
Dawson, P., & Guare, R. (2004). *Executive skills in children and adolescents: A practical guide to assessment and intervention*. New York: Guilford Press.
De-Weerdt, F., Desoete, A., & Roeyers, H. (2012). Working memory in children with reading disabilities and/or mathematical disabilities. *Journal of Learning Disabilities*, *46*, 461–472. http://dx.doi.org/10.1177/0022219412455238
Fleming, A. P., & McMahon, R. G. (2012). Developmental context and treatment principles for ADHD among college students. *Clinical Child Family Psychological Review*, *15*, 303–329. http://dx.doi.org/10.1007/s10567-012-0121-z
Gropper, R. J., Gotlieb, H., Kronitz, R., & Tannock, R. (2014). Working memory training in college students with ADHD or LD. *Journal of Attention Disorders*, 1–15. http://dx.doi.org/10.1177/1087054713516490
Guare, R., Dawson, P., & Guare, C. (2013). *Smart but scattered teens*. New York, NY: Gilford Press.
Heiman, T., & Precel, K. (2003). Students with Learning Disabilities in higher education: Academic strategies profile. *Journal of Learning Disabilities*, *36*, 248–258.
Henry, L. A. (2001). How does the severity of a learning disability affect working memory performance? *Memory*, *9*, 233–247. http://dx.doi.org/10.1080/09658210042000085
Horowitz-Kraus, T. (2014). Pinpointing the deficit in executive functions in adolescents with dyslexia performing the Wisconsin card sorting test: An ERP study. *Journal of Learning Disabilities*, *47*, 208–223. http://dx.doi.org/10.1177/0022219412453084
Hurkes, P. P. M., & Hendriksen, J. G. M. (2011). Retrospective and prospective time deficits in childhood ADHD: The effects of task modality, duration, and symptom dimensions. *Child Neuropsychology*, *17*, 34–50.
Johnson, E., Mellard, D. F., & Byrd, S. E. (2005). Alternative models of learning disabilities identification: Considerations and initial conclusions. *Journal of Learning Disailities*, *38*, 569–572.
Josman, N., & Rosenblum, S. (2011). A metacognitive model for children with atypical brain development. In N. Katz (Ed.), *Cognition, occupation, and participation across the life span: Neuroscience, neurorehabilitation, and models of intervention in occupational therapy* (pp. 223–229). Bethesda, MD: AOTA Press.
Katz, N., & Maeir, A. (2011). Higher-level cognitive functions enabling participation: Awareness and executive functions. In N. Katz (Ed.), *Cognition, occupation, and participation across the life span: Neuroscience, neurorehabilitation, and models of intervention in occupational therapy* (pp. 13–25). Bethesda, MD: AOTA Press.
Kavale, K. A., & Forness, S. R. (2000). What definitions of learning disabilities say and don't say – a critical analysis. *Journal of Learning Disability*, *33*, 239–256.
Kirby, A., Edwards, L., Sugden, D., & Rosenblum, S. (2010). The development and standardization of the adult development co-ordination disorders-Dyspraxia Checklist (ADC). *Research in Developmental Disabilities*, *31*, 131–139.
Lavoie, R. (2006). *It's so much work to be your friend: Helping the child with learning disabilities find social success*. New York, NY: Simon & Schuster.
Law on rights of students with learning disabilities at post-secondary school institutions, 2008. Retrieved from https://www.nevo.co.il/law_html/law01/999_941.html (In Hebrew).
Law proposal on rights of students with learning disabilities at post-secondary school institutions, 2007. Retrieved from https://www.nevo.co.il/law/15745 (In Hebrew).
Locascio, G., Mahone, M., Eason, S. H., & Cutting, L. E. (2010). Executive dysfunction among children with reading comprehension deficits. *Journal of Learning Disability*, *43*, 441–454.
National Center for Education Statistics, 2009. Fast Facts, Retrieved from http://nces.ed.gov/fastfacts/display.asp?id=64 (In Hebrew).
Owen, A. L., & Wilson, R. R. (2006). Unlocking the riddle of time in learning disability. *Journal of Intellectual Disabilities*, *10*, 9–17.
Pollak, Y., Kroyzer, N., Yakir, A., & Friedler, M. (2009). Testing possible mechanisms of deficient supra-second time estimation in adults with attention-deficit/hyperactivity disorder. *Neuropsychology*, *23*, 679–686.
Prevatt, F., Proctor, B., Baker, L., Garrett, L., & Yelland, S. (2011). Time estimation abilities of college students with ADHD. *Journal of Attention Disorders*, *15*, 531–538. http://dx.doi.org/10.1177/1087054710370673
Reiter, A., Tucha, O., & Lange, K. W. (2004). Executive functions in children with dyslexia. *Dyslexia*, *11*, 116–131. http://dx.doi.org/10.1002/dys.289
Rosenblum, S. (2012). Reliability and validity of the time organization and participation scale (TOPS). *Neuropsychological Rehabilitation*, *22*, 65–84.
Roth, R. M., Isquith, P. K., & Gioia, G. A. (2005). *Behavior rating inventory of executive function- adult version*. Lutz, Florida: Psychological Assessment Resources.
Scanlon, D. (2013). Specific learning disability and its newest definition: Which is comprehensive and which is insufficient? *Journal of Learning Disability*, *46*, 26–33.
Semrud-Clikeman, M. (2005). Neuropsychological aspects for evaluating learning disabilities. *Journal of Learning Disabilities*, *38*, 563–568.
Sharfi, K., & Rosenblum, S. (2014a). Activity and participation characteristics of adults with learning disabilities – a systematic review. *Public Library of Science*, *9*(9), e106657. http://dx.doi.org/10.1371/journal.pone.0106657
Sharfi, K., & Rosenblum, S. (2014b). Learning disabilities among adults: Application of the ICF model. *MIFGASH*, *22*, 205–220 (In Hebrew).
Sparks, R. L., & Lovett, B. J. (2009). College students with learning disability diagnoses: Who are they and how do they perform? *Journal of Learning Disability*, *42*, 494–510. http://dx.doi.org/10.1177/0022219409338746
Trainin, G., & Swanson, L. H. (2005). Cognition, metacognition and achievement of college student with learning disabilities. *Learning Disability Quarterly*, *28*, 261–272.
Ustun, T. B. (2007). Using the international classification of functioning: Disease and health in attention-deficit hyperactivity disorder: Separating the disease from its epiphenomena. *Ambulatory Pediatrics*, *7*, 132–139.
Varvara, P., Varuzza, C., Sorrentino, A. C. P., Vicari, S., & Menghini, D. (2014). Executive functions in developmental dyslexia. *Frontiers in Human Neuroscience*, *8*, 1–8.
World Health Organization. (2007). *International classification of functioning, disability and health (ICF)*. Geneva, Switzerland: Author.

Weiner, N. W., Toglia, J., & Berg, C. (2012). Weekly calendar planning activity (WCPA): A performance-based assessment of executive function piloted with at-risk adolescent. *American Journal of Occupational Therapy*, *66*, 699–708.
Willburger, E., & Landerl, K. (2010). Anchoring the deficit of the anchor deficit: Dyslexia or attention? *Dyslexia*, *16*, 175–182. http://dx.doi.org/10.1002/dys.404
Zakay, D. (1990). The evasive art of subjective time measurement: Some methodological dilemmas. In R. A. Block (Ed.), *Cognitive models of psychological time* (pp. 59–84). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.