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Music ergogenic effect on strength performance: randomized clinical test

Matheus Henrique de Abreu Araújo[1]; Jairo Teixeira Júnior[1,2]; Patrícia Espíndola Mota Venâncio[2]; Grassyara Pinho Tolentino[2]; William Alves Lima[2]; Viviane Soares[2]; Iransé Oliveira-Silva[2]

ABSTRACT

Background: Using preferred music during the exercise series was a differentiated way to increase muscle performance and fatigue slowdown, increasing the number of repetitions in these exercises. Despite of some studies present the effects of music, there is still a little music influence in strength training. **Objectives:** Verify the music effect on the strength performance in young adults, and the relation with the preferences of muscular grouping according to gender. **Methods**: a cross-sectional, controlled and crossover study was carried out with 20 physically active young adult participants (10 men). After previous laboratory evaluations, they underwent two exercise sessions, one experimental, where the participant performed 3 maximum series of exercises Barbell Curl and Leg Extensor seat listening to songs of their own choosing and another control session without music, adopting the series with greater repetition in each exercise for analysis. A minimum interval of 48 hours was adopted between each session. The protocol order (i.e. with music or without music) was made by the raffle. In the sessions, participants were asked to perform the maximum number of repetitions at 80% of the load determined in the laboratory. **Results**: The use of their preferred music significantly increased the number of repetitions in the two exercises, however, the preferences for muscular clusters characterized by the genders proved to be a determining variable. **Conclusion**: With the increasing of repetitions it was possible to observe an ergogenic resource to increase the performance in strength training, thus, a differentiated performance pattern was found between men and women in arm exercises when they use music.

Keywords: Ergogenic; Music; Gender; Force.

INTRODUCTION

Strength training has often been shown to be an important factor in the body's functional capacities development[1,2], such as strength, endurance and potency, as well as an increase in muscle mass, being mainly used for aesthetic purposes, increased quality of life, health, and accelerated rehabilitation processes[1,3,4]. It is also known as resistance training and assists in maintaining basal metabolic rate, complementing aerobic training to control body mass, and improving cardiac function in subjects with considerable losses in this function[5]. Outstanding benefits are closely related to how exercise programs are applied. For this reason, the incessant search of athletes and coaches for ways that improve performance during exercise is usually observed, and consequently, optimizing results and seeking to reach the limits of human performance[6,7]. Methods for performance enhancement and fatigue reduction are the targets of discussions by scholars, giving light to the analysis of ergogenic resources. Several resources are available on the market promising to improve the performance and reduced muscle fatigue processes, for example, the use of dietary supplements[8] that support performance research during physical exercise, being included in the methods category of internal influence, also there are the external influence methods[9], - the music. In line with dietary resources, a parallel line of analysis has been discussed in the literature, the role of music in relation to exercise. Among the various interferences of music in the exercises practice, the motivational factor has shown great importance, placing this as a relevant stimulus to be considered in the training programs[10].

Music significantly changes people's behavior, instigates the human being, affecting their body and cultural awareness[11-15]. In high-performance competitions, music becomes paramount for the athlete's concentration and relaxation[16]. As an ergogenic resource, it has the property of acting on the practitioner's mood levels, reducing the rate of perceived exertion during exercise, improving energy efficiency and, consequently, performance[10,17]. Most studies show a greater effect of music in moderate or submaximal activities[18,19], nevertheless, it is important to choose the right music

Corresponding author: Iransé Oliveira-Silva. Centro Universitário de Anápolis, (UniEVANGÉLICA), Anápolis (GO), Brazil. CEP 75075-754. Phone number: +55 62 3310-6637. Fax: +55 62 3310 6600. E-mail: iranse.silva@unievangelica.edu.br

2. Curso de Educação Física, Centro Universitário de Anápolis (UniEVANGÉLICA), Anápolis (GO), Brazil.

Full list of author information is available at the end of the article.

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according to the individual's preference so that they do not feel unmotivated during exercise. Another factor more relevant than performance in mood levels, should be taken into account when assessing the influences of music on exercise, would be the relationship between rhythm and repetition of movements. The musical rhythm can synchronize the execution, promoting kind of ideal movement coordination, being able to increase the speed and the performance efficiency, optimizing the work accomplished. Despite of some studies present the effects of music, there is still a little music influence in strength training. Hence, this study aimed to verify the effect of music on strength performance in young adults, and the relation with the preferences of muscle grouping as a function of gender.

MATERIALS AND METHODS

Procedures

This controlled, randomized crossover study was developed in the Exercise Physiology Laboratory (LAFEX) and in the bodybuilding room of the Goiás Physical Education and Physiotherapy College (ESEFFEGO / UEG) Goiânia (GO), Brazil. The study's protocol was approved by the Ethics Committee of the University Center of Anápolis - UniEVANGÉLICA (protocol number: 08601012 7 0000 5076). The sample consisted in 20 healthy adult (10 males), aged 18 to 24 years, university students, physically active, free of any pathology, randomly chosen (Table 1). As inclusion criterion, subjects had to have systolic blood pressure (SBP) equal to or below 130mmHg and diastolic blood pressure (DBP) equal to or below 85mmHg, BMI <30Kg/m^2, have between 18 and 30 years of age, are practicing resistance exercises, and were excluded if they had diabetes mellitus, heart failure, heart disease, kidney problems, or even orthopedic limitations that would impede the practice of exercises.

Table 1. Sample characteristics.

	Total Sample	Male	Female
Age (years)	20.7±1.9	20.8±2.2	20.7±1.6
	18-24	18-24	18-24
Weight (Kg)	64.5±10.6	70.6±11.5	58.4±4.5
	50.7-95.6	56.3-95.6	50.7-63.2
Height (m)	1.67±0.1	1.73±0.1	1.62±0.05
	1.52-1.90	1.57-1.90	1.52-1.68
BMI (Kg/m^2)	22.7±1.5	23.3±1.7	22.1±1.2
	20.3-26.5	20.3-26.5	20.5-24.4
SBP (mmHg)	112±9	118±4	106±8
	96-123	110-123	96-120
DBP (mmHg)	67±3	68±3	67±3
	63-72	63-72	63-72

Note: Kg - kilogram; m - meter; SBP- systolic blood pressure; DBP - diastolic blood pressure; mmHG - millimeter of mercury; BMI - body mass index

The invitation was held in the classrooms of the Physical Education and Physiotherapy courses, and interested academics should attend the Exercise Physiology Laboratory (LAFEX / ESEFFEGO-UEG) to receive all the explanations about the study. Those who agreed to participate signed a consent form, they scheduled a day to carry out anamnesis and physical assessments. The anamnesis had the format of a semi-structured interview with questions of attendance to the criteria of inclusion and recording as intrinsic motivation songs based on the participant's musical preference, and the adequate volume in the participant's perception.

Assessments

A 0.1 kg precision scale (R-110 CH, Welmy, São Paulo (SP), Brazil) and a graduated stadiometer (coupled to scale) in centimeters and 1 mm precision were used to measure weight and height, respectively. These variables were used to calculate the body mass index (BMI) by means of equation [BMI = weight (kg) / height (m) 2][23]. The body composition was evaluated following the protocol of 3 skinfolds Jackson and Pollock[24] with a skinfold measure (Premier, Cescorf® - Scientific, USA), precision of 0.1mm, the collection was performed in triplicate. There were measured the pectoral, abdomen and thigh folds for men, and the triceps, supra iliac and thigh folds for women. Blood pressure was measured by a semi-automatic pressure device (705 IT, OMRON, São Paulo (SP), Brazil), adopting the Brazilian Society of Cardiology guidelines[25]. The SBP and DBP measurement aimed to meet an inclusion criterion, and were performed after 5 minutes that the participant was seated.

For the 10 RM test, a specific warm-up was initially performed containing two sets of exercises, Barbell Curl and Leg Extensor seat, they were chosen because they characterize different muscle groups (upper and lower limbs). On this occasion it was standardized that the loads for heating should not exceed 0.5 * maximum load predicted by the evaluated[26]. After warming up, three attempts to reach the load for 10RM with the interval of five minutes between attempts and 20 minutes between exercises; on the first attempt the participant indicated the load based on their experience. The increase in load between the attempts was at least 2 kg for the Barbell Curl exercise, and 5 kg for the exercise Leg Extensor[6]. There were adopted the procedures described by Baechle & Earle[6]. Participants were instructed to perform a maximum of 10 repetitions per attempt even though the load would allow more; it was considered valid the attempt in which the volunteer performed 10 repetitions with the maximum possible load. When concentric failure occurs, before the tenth repetition is reached, the attempt was discarded. The maximum load reached in session 1 was used for the first attempt in the second session aiming at reaching the maximum load with the least number of possible attempts. The exercises execution speed was not standardized. Participants were verbally encouraged by the evaluators.

Evaluation protocol procedure

In the week following the 10RM test, all volunteers performed two evaluative protocols. The Experimental Protocol (EP) and Control Protocol (CP), with a 48h interval between them, applied in a random order, defined by a draw made in the participant's presence as soon as they reached the first day of the evaluative protocols. In the EP the participants performed the Barbell Curl exercises and the Leg Extensor, with 80% of the load identified by the 10 RM test (in case the load was intermediate the dumbbell / shin guard was brought closer to the nearest measurement) the participants were instructed to perform a warm-up for approximately five minutes involving the areas that would be required. After warming up they waited a minimum of 1 minute listening to the preset music selection with individually adjusted volume. Subsequently, this minimum time the subjects performed the exercises at the time they felt comfortable with the music was still playing. The volunteers were instructed to perform as many repetitions as possible until the concentric failure (i.e. muscle fatigue with inability to perform the requested range motion). Among the series of exercises the participants rested from 3 to 5 minutes[27]. Subjects were instructed do not worry about counting the number of repetitions and the researcher would be responsible for this function. In the control protocol the participants were submitted to the same conditions without the presence of the music. It's worth mentioning that the number of repetitions was recorded in each of the three series, and the largest number was selected for analysis. Participants' favorite songs were placed on individual media on a stereo (MP3 player, SONY, Japan). The volume on the set has been set according to the participant.

Statistical analysis

Statistical analyzes were performed using a statistical package (22.0, SPSS, IBM, Armonk, USA) with descriptions presented by mean ± SD. Normality was tested using the Shapiro-Wilk test. The largest repetitions number in the series of each exercise was selected for analyzes. There were calculated differences between the maximum number of repetitions for the direct and Leg Extensor exercises: (with music - without music). In order to analyze the measurement validity, there was used the intraclass correlation coefficient (ICC), and the percentage variation coefficient (%VC) was calculated to demonstrate the magnitude of the differences for the methods (i.e. with or without music) in each of the Exercises. There were used Pearson correlation (r), linear regression (R^2), and Bland-Altman plots were created to demonstrate the representation of measures between methods (i.e. with or without music), as well as differences between the sexes[28]. The level of significance was set at $p < 0.05$.

RESULTS

Table 2 indicates the mean load and the standard deviation expressed in kilograms (kg) obtained in the 10RM test. Taking into account the whole group (i.e. men and women together), the Barbell Curl without music had on average 14 ± 2 repetitions, whereas with music the average number of repetitions was 18 ± 2, whereas in the Leg Extensor it was obtained 14 ± 3 repetitions without music and 18 ± 3 repetitions with music. Figure 1 characterizes the changes which demonstrate that the music used during the exercises seems to have stimulated the subjects to perform more repetitions (p = 0,00 [Barbell Curl and Leg Extensor]).

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There was an increase in the mean number of repetitions in both exercises (ie Barbell Curl and Leg Extensor), but in a differentiated manner as a function of gender, this can be observed in Figures 2 until 5 (Bland & Altman).

Table 2. Load found in the 10RM test.

	Total sample	Male	Female
Barbell Curl (BC)-kg	10.1±5.1	14.4±2.7	5.8±2.5
	2-20	10-20	02-10
Leg Extensor **(LE)** -kg	29.8±7.9	33.7±7.9	25.9±5.9
	10-45	20-45	20-35

Note: The data was presented by mean, standard deviation, minimum and maximum, expressed in Kilograms.

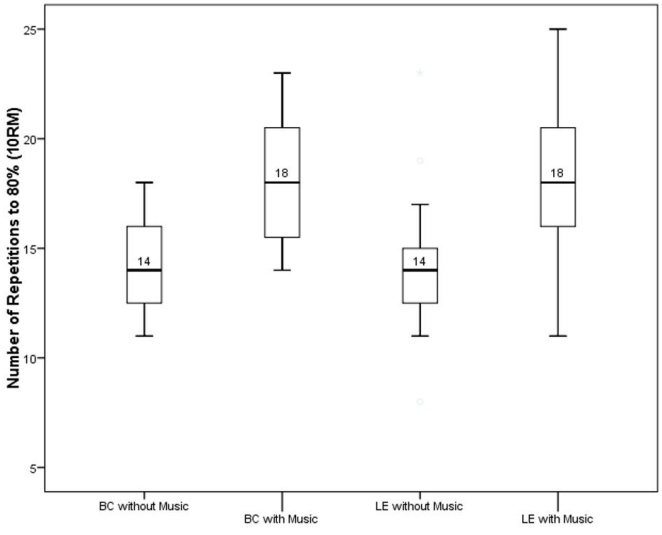

Figure 1. Changes in repetitions number in the Barbell Curl and Leg Extensor exercises as a function of music.
Note: Barbell Curl-BC; Leg Extensor-LE.

Table 3. Performance of participants in exercise Barbell Curl and Leg Extension, with and without music.

	Without music ±SD	With Music ±SD	average ±SD	Diff ±2SD	ICC	CV%	Correlation
Barbell Curl (rep)	14±2	18±2	16±2	4±2	0.91	17.2	0.921
	(11-18)	(14-23)	(12-20)				
Leg Extensor (rep)	14±3	18±3	16±3	4±4	0.84	17.1	0.824
	(8-23)	(11-25)	(9-24)				

Note: SD-Standard deviation; Diff- diference; ICC- intraclass correlation coefficient; VC-variation coefficient.

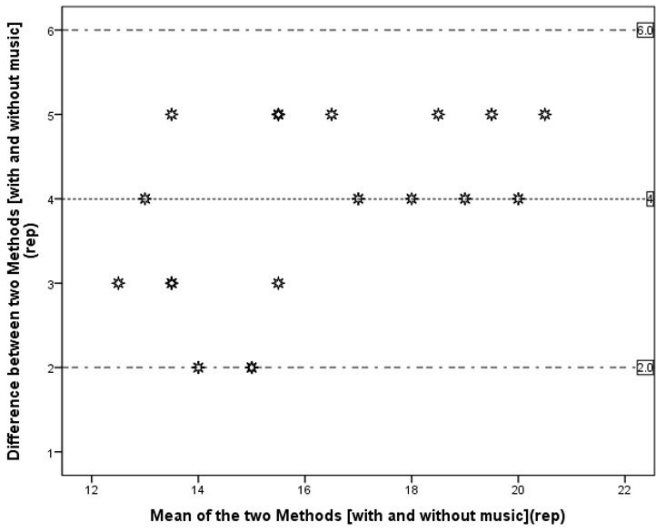

Figure 2. Differences between methods (with or without music) for the Barbell Curl exercise of the whole group evaluated expressed repetitions.

DISCUSSION

Using preferred music during the exercise series (i.e. Barbell Curl and Leg Extensor) was a differentiated way to increase muscle performance and fatigue slowdown, increasing the number of repetitions in these exercises. In addition to this factor, the results showed the increase in the number of repetitions occurs differently between men and women for upper limb exercise (i.e. Barbell Curl). The studies of Miranda and Godeli[11]; Valim et al.[12]; Rodrigues and Coelho Filho[21], Souza and Silva[18], and Karageorghis and Priest[22], already emphasized the importance of music in physical activity, especially preferred music, in generating flow state that leads to greater involvement with physical activity and promotes extramusical associations, an individual variable, with a decrease in the subjective perception of physical exertion in an acute way[18]. From the data collected so far, this is the first study to demonstrate in average values (from 14 to 18 repetitions) and absolute values (in the Barbell Curl: of the 20 evaluated, 15 increased 4 repetitions or more with the use of the music; Leg Extensor: of the 20 evaluated, 10 increased 4 repetitions or more with the use of music), the preferred music should be used during strength training to obtain the best performance in an acute way.

Another factor related to the use of music for performance improvement, previously presented by Nakamura et al.[20] and Sena and Grecco[14] pointed out that the use of non-motivational music may have no effect or more likely a deleterious effect, displeasure, not improving performance. This question is complex to be evaluated, since what motivates one person may discourage another[29], but it is important note that the songs used in the present study had an average of 121 beats per minute (BPM) [84-164], according to Doiron et al.[30], characterizes an ideal intensity. The considerable increase in the mean number of repetition to fatigue improving performance is in accordance with the findings of Nakamura et al.[20] who demonstrated the influence of the preferred music on the mood state improvement during exercises performed in intensity and improvement in the performance in the severe domain performed in the cycloergometer. Similarly, the study by Thakare et al.[19] with subjects did not trained in submaximal running exercise on the treadmill, who presented no correlation between exercise duration, music and heart rate, presented a longer duration of the race with music. In contrast, the study by Sena and Grecco[14] with running on the treadmill in the presence of 120bpm and 140bpm music did not show significant variation in the heart rate increase, associating the good mood after the race plus the release of beta-endorphin in the body during exercise. On the other hand, the systematic review developed by Karageorghis and Priest[22] present important benefits that music exerts on performance in physical activities. The volume individually regulated by the research patient is in agreement with the study by Rodrigues and Coelho Filho[21] and Souza and Silva[18] that characterized the high volume is dependent on the subjective perception of the individual.

In the present study, the application of music as an ergogenic factor occurred acutely which is why we cannot say that this is the best alternative. A previous study[18] already warned the decrease of the music effects in the performance in race program as the use of the music happened to be chronic. This decrease may be associated with motivation loss or mood for the same music in chronic use. Therefore, new studies should be developed to test this hypothesis. It was evidenced that the increase in the number of repetitions occurs differently between men and women for upper limb exercise (i.e. Barbell Curl), this fact should be better investigated, since there is a

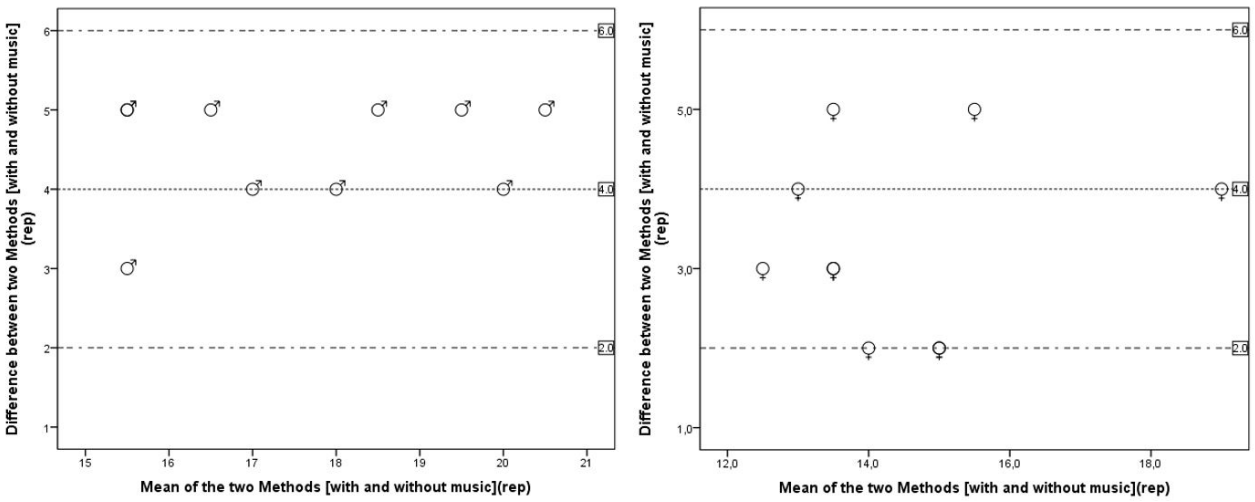

Figura 3. (a) Differences between men; (b) Difference between women.

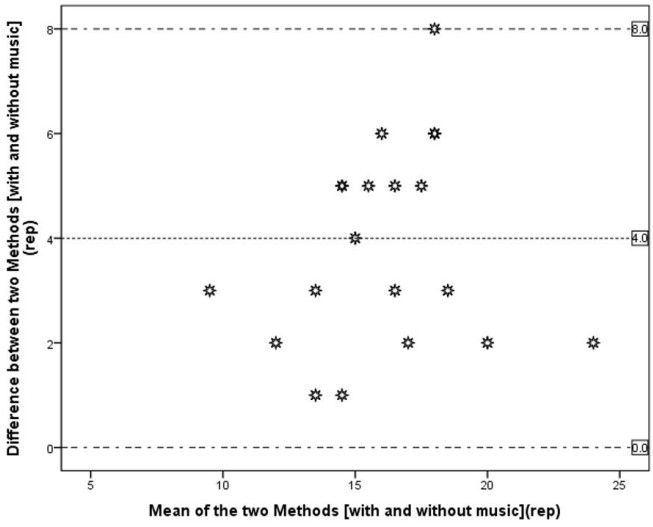

Figure 4. Differences between methods (with or without music) for the Leg Extensor of the whole group evaluated expressed repetitions (data from Table 3).

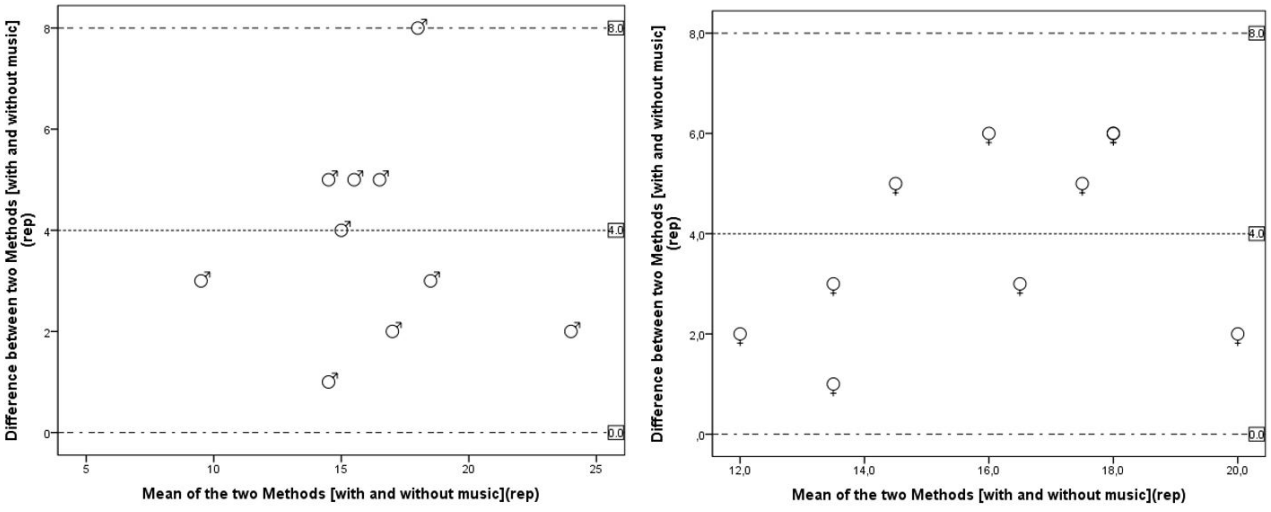

Figura 5. (a) Differences between men; (b) Difference between women.

stigma that men like to train arm and women have a certain aversion, in the meantime, scientific evidence is scarce.

CONCLUSION

Using preferred music during the resisted exercises significantly increased the number of repetitions, altering the strength level of the subjects and similarly for the different muscle groups (i.e. upper and lower limbs), functioning as an ergogenic resource to increase performance in strength training. The data demonstrate that there is a differentiated pattern of performance between men and women in arm exercises when using music, considering the existence of another motivating factor related to the ideal of body esthetics between men and women.

AUTHOR'S CONTRIBUTION

MHAA, study design, data collection, data analysis and interpretation of the results, writing of the manuscript. JTJ, data analysis and interpretation of the results, writing of the manuscript. IOS, study design, data analysis and interpretation of the results, writing of the manuscript.

CONFLICTS OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

AUTHOR DETAILS

1. Laboratório de Fisiologia do Exercício (LAFEX), Universidade Estadual de Goiás (ESEFFEGO/UEG), Goiânia (GO), Brazil.

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