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CONTENTS

Research Articles

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Research Article

Brain Breaks Physical Activity Solutions® in higher education: Randomized controlled trial among Turkish university students

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ABSTRACT

A substantial volume of empirical evidence exists regarding the positive effects of technology-supported physical activity (PA) solutions in school children. However, a lack of potential impact of these solutions in higher education settings exists. The aim of this study was to examine the effects of Brain Breaks PA Solutions® on university students' attitudes toward PA. This study used a pre-test and post-test with a quasi-experimental design and convenience sampling. Students (n = 521) from seven different faculties of a public university in the Cappadocia region of Turkey volunteered as study participants and were randomly assigned to either experimental (n = 263) or control (n = 258) groups. During a 3-month intervention, the experimental groups received Brain Breaks PA Solutions® videos. Student attitudes toward PA were measured using the attitudes toward PA Scale (APAS) before and after the intervention. Repeated measures analysis of variance indicates a time interaction effect for PA benefits. Time-by-group interaction effects with varying effect sizes were found for most APAS variables with the greatest gain noted in the experimental groups for fun, followed by learning from the videos, and self-efficacy ($P < 0.05$). This study provides evidence that technology-supported PA programs in higher education settings positively impact students' attitudes toward PA.

Keywords: Physical activity, Public health, Technology, Youth

INTRODUCTION

More physically active individuals for a healthier world are needed and is stated as a goal in the World Health Organization (WHO) 2018–2030 Global Action Plan on Physical Activity (PA) (WHO, 2022). This need is justified because 23% of adults and 81% of young people between the ages of 11 and 17 do not meet WHO's recommendations for PA needed for better health. Likewise, Guthold *et al*. (2018) reported worldwide insufficient PA from 2001 to 2016 in 1.9 million participants from 168 countries. The age-standardized physical inactivity rate was 27.5% (Guthold *et al*., 2018) Individuals were considered physically active by using guidelines from the American Dietetic Association and the American College of Sports Medicine. The physically active individual is required to do moderate-intensity PA for at least 30 min every day or most days of the week. PA is considered an essential determinant for improving quality of life, adding

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to a healthy lifestyle, and reducing chronic disease risks such as hypertension, obesity, and diabetes (Anderson and Durstine, 2019). The aim of increasing PA directly contributes to the United Nations' sustainable development goals (SDG) (2020), particularly to SDG#3 (Good health and well-being) (Popeska *et al*., 2022; Salvo *et al*., 2021; Uvinha *et al*., 2022). Information found in the literature supports that sedentary lifestyles are on the rise globally, associated with increased computer use, video game use, and television watching (Barwais *et al*., 2013; Gao *et al*., 2019) and the health effects of individuals at all ages are negatively impacted (Ferreira *et al*., 2022). Decreased PA levels can start in early adolescence and continue to decline into late adolescence and early adulthood (Corder *et al*., 2019; Winpenny *et al*., 2020; Liu *et al*., 2018; Chai *et al*., 2022). Life events such as life transitions are known to negatively affect PA levels and other lifestyle behaviors Winpenny *et al*., 2020). As these early life years are an important period for life change, students are often faced with increased stress, loneliness, nostalgia; decreased level of self-confidence, and lack of peer communication. These factors often lead to misunderstanding and conflict (Liu *et al*., 2018; Conley, Travers and Bryant, 2013; Kim and Kuan, 2020). The transition of graduating from public school to attending a university is an important time when youth need support in preventing PA decline (Winpenny *et al*., 2020; Gropper *et al*., 2020). Conversely, PA participation in many different forms accrues countless benefits. Students involved in moderate and high-level PA have better psychological well-being (Granero-Jiménez *et al*., 2022; Lapa, 2015), and greater quality of life (Abdullah *et al*., 2019; Zhang, Chen, B., and Chen, W, 2021). These health benefits increase with increased weekly PA participation (Broáni *et al*., 2013). Most university students have difficulty engaging in adequate PA due to excessive class hours and course requirements, lack of self-discipline, lack of PA facilities, and/or PA amenities. Ferreira Silva *et al*. (2022) identified lack of time, motivation, and available facilities as main barriers to being PA among high school and university students. A Turkish study (Ölçücü *et al*., 2022) confirmed lower university students PA rates while more than half of students evaluated had no regular PA participation or had insufficient PA levels. Therefore, identifying and recommending different PA forms that do not require extensive time, finances, specific facilities, and facility access is needed.

Using short PA breaks to combat sedentary lifestyles provides insight into behavior change. For instance, Taylor *et al*. (2013) used workplace booster breaks to promote health through increased PA. Henning *et al*. (1997) found positive productivity and well-being resulting from frequent short rest PA breaks while doing computer work. Barwais *et al*. (2013) used personal activity monitor-based intervention programs to reduce sedentary behavior and increase PA levels in daily living among sedentary adults. Bedard *et al*. (2019) completed a systematic review and meta-analysis on studies evaluating school-aged children and found improved educational outcomes were best impacted in classrooms incorporating PA when compared to traditional sedentary classrooms. Papadopoulos *et al*. (2022) recently conducted a systematic review regarding brief periods of classroom-based PA intervention on primary school-aged children and found enhanced enjoyment and well-being benefits. Schools are known as special places for promoting PA as children spend much of their time in school. In this regard, when considering university students, universities also have an important role in promoting PA by providing facilities and amenities encouraging regular PA participation. One way that PA is incorporated into the classroom is through the use of learning that incorporates PA breaks or brain breaks. (Carlson *et al*., 2015; Käll *et al*., 2014).When considering the length of teaching hours, longer teaching periods often used in university settings is tiring for both students and instructors. During long teaching sessions, students and instructors can easily participate in videos such as the ones developed by Brain Breaks PA Solutions®. The literature clearly supports that using PA classroom breaks contributes to enhanced productivity, well-being, self-efficacy, and better attitudes toward PA participation (Carlson *et al*., 2015; Käll *et al*., 2014). Therefore, incorporating active breaks into higher education settings potentially increases students' mood, promotes effective learning, and likely enhances instructors' productivity.

Studies conducted with elementary and middle school children provide strong evidence for the positive effects of classroom PA breaks. HOPSports Brain Breaks PA Solutions® is one such program using multilevel interventions combining classroom-based PA with modern technology (Chin *et al*., 2012). This technology-supported intervention integrates various types of body movements in 3–5-min online videos aimed to enhance PA during educational lessons promoting students' interest in learning and well-being. Online exercises are designed specifically for use in individual or group settings to encourage students to become physically active, acquire new motor skills, learn new languages, and develop an appreciation for cultural knowledge in art and music (Chin *et al*., 2012). Information found in the literature supports conclusions that Brain Breaks PA Solutions® positively impact cognitive functioning (Mullender-Wijnsma *et al*., 2015), academic achievement (Donnelly *et al*., 2016; Watson *et al*., 2017), enhanced attitudes toward PA (Bonnema *et al*., 2020; Emeljanovas, 2018; Mok *et al*., 2020; Uzunoz *et al*., 2017), self-efficiency in learning (Glapa *et al*., 2018; Popeska *et al*., 2018), increased PA interest (Abdullah *et al*., 2019; Zhou *et al*., 2021), improved physical fitness (Bonnema *et al*., 2020), Improved goal orientation (Mok *et al*. 2020; Mok *et al*, 2016), improved holistic learning (Uzunoz *et al*., 2017; Popeska *et al*., 2018; Kuan *et al*., 2019), and improved classroom behavior (Podnar *et al*., 2018). Brain

Breaks PA Solutions® are also associated with improved cognitive and behavioral processes and internal feelings (Rizal *et al*., 2019). Teachers also find PA break videos useful to improve student focus, improved cooperation, and better interaction with children (Rizal *et al*., 2019). Study subjects report that PA breaks are enjoyable (McMullen *et al*., 2014) while instructors note PA breaks are easy to apply (Jovanova-Mitkovska and Popeska, 2019).

Although many studies are found in the literature regarding the effect of Brain Breaks PA Solutions® on school children, few studies exist regarding the influence of brain PA breaks on university students. Thus, the study aimed to examine the effects of Brain Breaks PA Solutions® on university students' attitudes toward PA in the Cappadocia region of Turkey.

METHODOLOGY

Study Design and Participants

This quantitative study used a pre-test and post-test with a quasi-experimental design. The study participants comprised 521 university students from seven faculties of a public university found in the Cappadocia region of Turkey (Education Sciences, Health Sciences, sports sciences, Theology, Foreign Languages, Science and Literature, Economics, and Administrative Sciences). Availability and volunteerism (Onwuegbuzie and Collins, 2007) were the basis for sample selection. Thus, Tourism, Fine Arts, and Engineering Faculties were not included in this study. Participant's characteristics are presented in Table 1.

All university academic faculties were represented in both experimental and control groups. Classrooms from academic faculties were randomly assigned to either experimental or control groups. Starting study participants were 579 students (265 males and 314 females). Subjects beginning in the experimental group were 313 and in the control group were 266. Forty-nine males and one female from the experimental group and five males and three females from the control group did not meet the requirements for continued study protocol participation. Consequently, a total of 58 students were omitted from statistical analysis. Initially, equal number of males and females were assigned to the experimental and control groups, but more males in the experimental groups were unable to complete the study protocol participate. Thus, more female students finished study protocols. After data extraction, final male numbers were 211 (40.5%) and female numbers were 310 (59.5%) (Mean age = 20.67, SD = 2.4 years). The total number of participants finishing the experimental group was n = 263 and total participants finishing the control was n = 258.

Independent sample t-tests showed that no significant statistical difference existed between the experimental and control groups at pre-test in participants' attitudes toward PA as measured by the PA Scale (APAS) variables ($P > 0.05$).

Intervention: Brain Breaks PA Solutions®

Participants in the experimental group received Brain Breaks PA Solutions® (http://hopsports.com/what-is-brain-breaks) as a 12-week intervention completed three school days each

Table 1: General characteristics of the participants (n=521)

Variables	Total n=521 (%)	Experimental Group n=263 (50.5%)	Control Group n=258 (49.5%)
Age (years)	20.67±2.42	20.68±2.61	20.66±2.22
Gender			
Male	211 (40.5%)	90 (34.2%)	121 (46.9%)
Female	310 (59.5%)	173 (65.8%)	137 (53.1%)
Year level			
Year 1	166 (31.9%)	110 (41.8%)	56 (21.7%)
Year 2	115 (22.1%)	-	115 (44.6%)
Year 3	240 (46.1%)	153 (58.2%)	87 (33.7%)
Faculties			
Education Sciences	115 (22.1%)	63 (23.9%)	52 (20.2%)
Health Sciences	113 (21.7%)	52 (19.8%)	61 (23.6%)
Sport Sciences	70 (3.4%)	35 (13.3%)	35 (13.6%)
Theology	69 (13.2%)	47 (17.9%)	22 (8.5%)
Foreign Languages	59 (11.3%)	27 (10.3%)	32 (12.4%)
Science & Literature	55 (10.6%)	23 (8.7%)	32 (12.4%)
Economics & Administrative Sciences	40 (7.7%)	16 (6.1%)	24 (9.3%)

week in 3–5-min segments. Each Brain Breaks PA Solutions® video included warm-up exercises, elements from different sports, and traditional dances with customary or popular music from different countries. Before the intervention, university academic staff members for the experimental group were instructed by trained researchers in intervention implementation procedures and how to lead exercises. The academic staff was also provided with online access to the Brain Breaks PA Solutions® administration platform. Students in the control group did not receive any Brain Breaks PA Solutions® intervention and received only normal curriculum instruction. After providing information about the research, all testing was applied by researchers in classrooms and completed anonymously using a code designed to match students' responses at pre- and post-intervention testing without revealing the student's identity.

Measures

The original APAS questionnaire (Mok *et al*., 2015) was designed to measure students' attitudes toward PA and uses a four-point Likert scale with options of strongly disagree, disagree, agree, and strongly agree and contains seven scales:

- Benefits scale measures students' perceived benefits of PA with 10 items
- Importance scale measures students' perceived importance of PA with 5 items
- Learning scale measures students' learning from the videos with 11 items
- Self-efficacy scale measures students' self-efficacy in selecting video exercises for themselves with 4 items
- Fun scale measures students' interest in doing PA with 14 items
- The fitness scale measures students' confidence in their own fitness with 8 items
- Personal best scale measures students' orientation to their personal best goals when engaging in PA with 5 items.

Strong internal consistency and validity for APAS in school children was established by national studies completed in Poland (Glapa *et al*., 2018), Macedonia (Popeska *et al.*, 2018), Turkey (Uzunoz *et al*., 2017), Lithuania (Emeljanovas *et al*., 2018), Malaysia (Kuan *et al.*, 2019; Rizal *et al*., 2019; Hajar *et al*., 2019), and international studies (Mok *et al*., 2015; Mok *et al*., 2020).

Adaptation of the APAS for higher education students in Turkey was conducted by Dinc *et al*. (2019). The validity and reliability of the Turkish APAS version were verified for higher education population with 38 items consisting of six subscales: Benefits of PA (7 items), learning from videos (8 items), self-efficacy (3 items), fun (7 items), self-confidence on physical fitness (8 items), and trying to do personnel best (5 items). Demographic information regarding students' age, gender, college year level, and faculty was gathered at the beginning of the session when the APAS was completed. Both groups finished the Turkish APAS version for higher education in about 15 min both at pre- and post-intervention times (Dinc *et al*., 2019).

Ethical Approval Intervention: Brain Breaks PA Solutions®

This study was conducted in accordance with the Declaration of Helsinki and ethical approval was obtained from University's Institutional Review Board where this study was undertaken. All research procedures were conducted by following university ethical principles, and all participants took part voluntarily and signed informed consent forms.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS, version 27.0) was used for data analyses. Data from all academic faculties were pooled after cleaning and matching data from pre-test and posttest. Descriptive statistics were used to describe subject general characteristics (means, standard deviations). An independent samples *t*-test was used to compare the experimental and control groups at pre-test to assess the extent to which the groups were statistically comparable before intervention. Changes in variables from pre-test to posttest were evaluated using repeated measures of variance analysis (ANOVA) to determine time and time by group effects. Differences were considered statistically significant at $P < 0.05$. Effect sizes of significant differences were evaluated using partial eta-squared (η^2). Values of partial η^2 equal to 0.006, 0.009, 0.011, and 0.012 were considered as small effects according to Richardson (Richardson, 2011).

RESULTS

Study results demonstrated that the experimental group gained significantly more benefits than the control group from pre-test to post-test. A repeated-measure ANOVA indicated significant time and time by group interaction effects for some subscales of the APAS as shown in Table 2.

Time by group interaction effect was significant for three subscales of APAS, namely, "Fun" ($F = 6.226$*, $P < 0.05$*); Learning from videos" ($F = 5.533$*, $P < 0.05$*) and "Self-efficacy" ($F = 4.642$*, $P < 0.05$*) and time effect was significant for the "Benefits of PA" subscale ($F = 5.382$*, $P < 0.05$*). Based on the partial η^2, magnitude of the effect of the time by group interaction was small for the scores on these variables.

DISCUSSION

The aim of this study was to examine the effects of Brain Breaks PA Solutions® on university students' attitudes

Table 2: Descriptive statistics of the Experimental (*n*=263) and Control Groups (*n*=258) at pre-test and post-test, and the results of repeated measures ANOVA

Variables	Groups	Pre-test	Post-test	Time		Time x Group	
		M±SD	M±SD	*F* (*p*)	η^2	*F* (*p*)	η^2
Benefits	EXP	3.41±0.46	3.52±0.44	5.382*	0.010	3.393	0.006
	CON	3.40±0.57	3.42±0.49				
Learning	EXP	3.03±0.54	3.18±0.53	0.850	0.002	5.533*	0.011
	CON	3.07±0.56	3.07±0.55				
Self-efficacy	EXP	3.27±0.53	3.42±0.49	0.209	0.000	4.642*	0.009
	CON	3.21±0.59	3.23±0.59				
Fun	EXP	3.05±0.51	3.20±0.52	0.480	0.001	6.226*	0.012
	CON	3.10±0.55	3.12±0.52				
Fitness	EXP	3.21±0.55	3.27±0.56	1.523	0.003	0.309	0.001
	CON	3.22±0.57	3.25±0.55				
Personal Best	EXP	3.28±0.59	3.36±0.58	0.059	0.000	0.164	0.000
	CON	3.27±0.66	3.32±0.56				

Notes: M=Mean, SD=Standard deviation, EXP=Experimental group, CON=Control group, *P<0.05. ANOVA: Analysis of variance

toward PA in the Cappadocia region of Turkey. The findings support that 12 weeks of classroom PA break participation positively affected university students' attitudes toward PA with improvements in three of the six APAS variables. The experimental group significantly increased attitudes toward PA enjoyment when engaging in PA, learning from videos, and self-efficacy in using exercise videos when compared to the control group. Significant improvements in perceived PA benefits were also found in the experimental group.

This study revealed that technology-assisted videos do support regular PA participation. Students indicated that PA during class time was interesting and fun, and the videos had a positive effect on student enjoyment and improved their motivation for becoming PA. The use of short exercise videos supports the claim of Bonnema *et al*. (2020) who reported that technology provides a higher level of enjoyment for school children in South Africa. Findings from this study are also supported by studies conducted in China (Zhou *et al*., 2021), Lithuania (Emeljanovas *et al*., 2018), Macedonia (Popeska *et al*., 2018), Malaysia (Rizal *et al*., 2019; Hajar *et al*., 2019), Poland (Glapa *et al*., 2018), Singapore (Balasekaran *et al*., 2021), and Turkey (Uzunoz *et al*., 2017). In these studies, the effectiveness of classroom Brain Breaks PA Solutions® videos on school children were evaluated using quasi-experimental designs. (Mok *et al*., 2020) made comparisons of Brain Breaks PA Solutions® videos in participants from eight different countries. When the results from Mok *et al*. (2020) of school children are compared with the results of this present study also using Brain Breaks PA Solutions® videos, university students have similarities regarding the perceptions of fun and enjoyment while engaging in PA, learning from videos, and promoting self-efficacy by using exercise videos. These findings are related to the video content which combines elements from various sports, warm-up exercises, music, and traditional dances with customary or popular music from different countries. Participants learned from the videos the structure for PA breaks, regular PA participation, and skills gained by using technology while having the autonomy to choose different videos. The results also support that university students' can effectively learn from videos and gain self-efficacy in using exercise videos. Sprenger and Schwaninger (2021) state the use of digital learning technologies in higher education is becoming increasingly widespread due to advantages such as easy of applicability, affordability, and measurability in crowded classrooms. These factors are considered supportive for university lecturers to use Brain Breaks PA Solutions® in higher education courses. Short PA breaks to refresh the mind and the body while allowing for a renewed focus on the same task.

University lecturers involved in the implementation of this study protocols provided feedback concerning the use of in-class exercise videos. Their comments support that students who are involved in sports or PA, participated in the class short video exercises without hesitation or boredom. On the contrary, students who had given up sports and PA, at times had difficulty in performing video exercises but slowly improved self-efficacy with learning from video exercises. All participants when asked reflected on their enjoyment in PA participation. Significant improvements in self-efficacy in using exercise videos is linked with the construct of Bandura's (1997) social cognitive theory which relates to the belief in one's own ability to take the necessary actions to achieve desired outcomes. Even students who have

never played sports, or who have never been involved in PA, given the opportunity to dance, demonstrate improved skills specific to different cultures and moved throughout the classroom exercise videos. These applications influence students' behavior preferences and encourage chosen behavior. Therefore, after the implementation of Brain Breaks PA Solutions® PA interventions, university students' confidence in achieving and maintaining behavioral change regarding PA was enhanced. This finding is also in line with the results of Papalia *et al*. (2018) who in working with college students suggested that using information technology-based tools such as smart watches, pedometers, and heart rate monitors was important to increase motivation for PA participation. Unlike students studying in the education and sport sciences fields, Brain Breaks PA Solutions® created a very different and novel atmosphere when combined with traditional teaching methods, especially for students studying in other university academic disciplines (e.g., Theology, Science and Literature, Economics, and Administrative Sciences).

As reported in other studies conducted with children (Bonnema *et al*., 2020; 2022; Glapa *et al*., 2018; Popeska *et al*., 2018; Zhou *et al*., 2021; Hajar *et al*., 2019; Balasekaran *et al*., 2021), university students lacked significant improvements in self-perception of physical fitness and trying to achieve personal best when doing PA. This difference is likely attributed to the amount of time and intensity of movement during exercise videos. To ensure active regular PA participation, especially in this age group, a competitive environment was suppressed and fun by the videos was emphasized. Implementing videos featuring moving to music in an enjoyable manner was deemed more important for university students to relax. At the same time, participating in combat and fun-type sports were vehicles for university students to get away from academic routines. Reported research findings predicate immediate effects during a PA session when accompanied by music (Terry *et al*., 2020). The music reduces physical exertion, increases activity engagement and enjoyment, and is associated with higher exercise intensities (Terry *et al*., 2020). Unlike the findings of the present study where physical fitness did not improve, Bulca *et al.* (2022) used Fitnessgram Test Battery in Turkey school children and Bonnema *et al*. (2022) used EUROFIT test battery in South Africa school children found physical fitness level improvements after applying Brain Breaks PA Solutions® PA programming. The different finding may be related to the selected videos that solely focused on improving children physical fitness levels. A different perspective is that a challenging skill resulting in children development is easier for university students when the activity is perceived as fun. Zhou *et al*. (2021) states that Brain Breaks PA Solutions® videos consisting of movements from simple to complex with difficulty increasing linearly are more effective for children self-perception of physical fitness, and thus, children work harder to do their best in PA participation. Therefore, academic university professionals might choose video containing physically demanding movements to encourage university students to do their best at PA participation.

As with all studies, this study had limitations that future studies should address. Accordingly, the most commonly used Brain Breaks PA Solutions® intervention implementation process was followed using a 12-week intervention period to evaluate attitude and behavior change toward PA while the impact of longer intervention periods is unknown. The unique aspect of this quasi-experimental study was the evaluation of the Brain Breaks PA Solutions® experiences in higher education settings, and the sample was representative of a broad group of academic faculties. Although this study can be used as a guide because of the quantitative research methodology used, in-depth evaluation of student and teacher opinions using quantitative methodology needs to be completed and will add significantly to the literature. As only verbal feedback from professors involved in this intervention, these comments were not included in data analysis. All data collected were student self-reported, and an imbalance in the number of 2nd year university students existed among the experimental and control groups. Future research studies should consider a much larger number of higher education institutions at both the national and international levels. Finally, studies are needed that randomized subject allocated to the experimental and control groups within each category (e.g., gender, student academic year level, and academic faculty), and use a larger number of subjects would provide greater statistical power.

CONCLUSION AND RECOMMENDATIONS

The aim of this study was to examine the effects of Brain Breaks PA Solutions® on university students' attitudes toward PA using subjects from the Cappadocia region of Turkey. Results support that 12 weeks of regular participation in classroom PA breaks positively affected university students' attitudes toward PA. Improvements were found in fun and enjoyment gained when engaging in PA, learning from videos, and promoting self-efficacy by using exercise videos. In this respect, based on the results of related studies found in the literature, children and higher education students are not different. In conclusion, the technology-supported Brain Breaks PA Solutions® has a positive impact on promoting PA in higher education settings. When implementing the findings of this study, collaboration between researchers, higher education administrators, and public school administrators and teachers are important. Such involvement will likely provide better PA participation within the context of holistic student education, teachers, and instructors.

AUTHOR CONTRIBUTIONS

Conceptualization, F.S.U., M.K.C.; methodology, F.S.U., S.C.D.; validation, S.C.D., M.M.C.M, formal analysis, F.S.U., S.C.D., M.M.C.M; investigation, F.S.U., S.C.D., B.P., G.K.; resources, M.K.C.; data curation, S.C.D., M.M.C.M; writing-original draft preparation, F.S.U., B.P., G.K.; writing-review and editing, F.S.U., G.K., M.M.C.M, I.C., C.R.E., J.L.D.; visualization, M.K.C., M.M.C.M; supervision, M.K.C.; project administration, M.K.C. All authors have read and agreed to the published version of the manuscript.

DATA AVAILABILITY STATEMENT

Data are available from the corresponding author on reason able request. The data are not publicly available due to privacy restrictions.

DECLARATION OF COMPETINGINTEREST

All authors declared that there are no real or potential conflicts of financial or personal interest.

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