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The effect of three different sets method used in resistance training on hypertrophy and maximal strenght changes

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Abstract

Background and Study Aim To compare the effects of three different sets method, which is frequently used in resistance training, on strength and hypertrophy values.

Material and Methods Thirty-three young male athletes with similar daily activities and nutrient intakes at the Fitlife fitness center in Sakarya were included in the study. Participants were randomly divided into three different groups as Modified German Volume Training (MGVT) (n=11, 21.5 ± 2.4 years), Super Set (SS) (n=11, 22.4 ± 2.9) and Giant Set (GS) (n=11, 23.0 ± 4.3 years). The study was started with a total of thirty-three people, but two participants in the Giant set group were excluded from the measurements because they left the study due to personal reasons. Strength, muscle thickness and cross-sectional area (CSA) measurements were made in the upper extremity muscles before and after the six-week training period.

Results After six weeks of training, significant increases were observed in the cross-sectional area and thickness ($p<0.05$) of pectoralis major, deltoid, and latissimus dorsi muscle groups in all three groups, and in the strength parameter ($p<0.05$) in bench press, barbell row and shoulder press exercises. There was no difference in strength, muscle cross-sectional area and thickness parameters between the groups ($p>0,05$).

Conclusions Modified German Volume Training (MGVT), Super Set (SS) and Giant Set (GS) methods reveal that there is no difference between the set methods in the 1 Repetition Maximum (1RM) strength and hypertrophy development of young male individuals who do not have a history of resistance exercise but have completed the adaptation period, and that there is an improvement in all set methods.

Keywords: muscle hypertrophy, strength, muscle thickness, cross-sectional area

Introduction

Resistance training is proven to increase lean body mass, strength, and power (ie hypertrophy). Nevertheless, it was found that it can enhance physical performance (such as jump height), which can support sporting outcomes [1]. However, many people practice resistance exercises because of their effectiveness in increasing muscle mass and strength [2]. Various methods are used in a training routine to maximize efficiency in resistance training [3, 4]. Manipulation of the various acute variables used by trainers and athletes (e.g., intensity, volume, exercise selection and sequence, time under tension and rest interval) provides increased efficiency in muscle mass gain and avoids entering a plateau phase [5].

German Volume, Superset, and Giant Set techniques are the most popular among these resistance training approaches. German Volume Training (GVT) is a technique that national weightlifting coaches employ to build their athletes' muscle mass off-season [6]. A GVT session traditionally involves performing 10 sets of 10 repetitions for one core compound resistance exercise, and this method uses up to two core compound exercises in one training session [7]. In order to achieve high training volume while applying the sets, it is performed at intervals of 1-20 repetitions with loads of around 60% of 1RM, and the resting time between sets is relatively shorter (60-90 seconds) to compared to a strength training program increase metabolic stress (e.g., lactate) [6]. The "superset" method, on the other hand, includes varying the amount of time between sets or exercises for the same muscle area as a means of boosting training intensity. This environment accepts the validity of "superset", which groups exercises targeting the same muscle area, to increase exercise intensity [8, 9, 10]. One of the methods used to increase metabolic stress is the Giant Set method. The Giant Set method involves performing two or more exercises that appeal to the same muscle group without any pause between them [11]. Increasing the levels of mechanical strain

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and metabolic stress, these strategies can trigger the activation of factors presumed to be involved in anabolism, such as improvement in hormonal activities, increase in protein synthesis and muscle fiber diameter, and muscle swelling, and induce muscle hypertrophy [12].

When the current literature investigating the effects of these three sets method is examined, it is seen that authors [2, 6] compared GVT and Modified German Volume Training (MGVT) methods in their studies. While the GVT method includes 10 sets of 10 repetitions, MGVT includes 5 sets of 10 repetitions, and when the results of these studies are examined, it was determined that the ideal number of sets for muscle mass and strength development is in the range of 4-6 sets. Brentano et al. [8] and Kelleher et al. [13] compared superset and traditional resistance training methods in their studies. When the results were examined, it was observed that the superset method caused more metabolic stress and muscle damage. However, it is known that more metabolic stress and muscle damage will contribute positively to the development of hypertrophy. Fink et al. [12] compared superset and traditional resistance training methods in his study. When the results were examined, improvements were observed in both groups in muscle thickness and muscle cross-sectional area, but no difference could be detected between the groups.

In such studies, it is seen that training experience can positively affect the stimulation of the targeted muscles. Compared to other athletes, bodybuilders have a unique sensitivity to focusing on metabolic stimuli [14] and muscle stimulation [15].

The aim of this study is to compare the effects of three different sets method, which is frequently used in resistance training, on strength and hypertrophy values, and in this context, there is no study comparing the effects of these three sets method when the literature is examined. We think that this research will contribute to enrich the literature on training variables and to give a different perspective to this field.

Materials and Methods

Participants

Thirty-three young male athletes with similar daily activities and nutrient intakes at the Fitlife fitness center in Sakarya were included in the study. Participants were randomly divided into three different groups as Modified German Volume (n=11, 21.5 ± 2.4 years), Super Set (n=11, 22.4 ± 2.9) and Giant Set (n=11, 23.0 ± 4.3 years). The study was started with a total of thirty-three people, but two participants in the Giant set group were excluded from the measurements because they left the study due to personal reasons. Eligibility criteria are that the participants should be between the ages of 18-27, practice regular exercise, do not use smoking and alcohol, do not take drugs that will affect their blood levels and performance, have no health problems, and have at least 1 month of resistance training adaptation. The experiment was conducted during the period between midterm exams, as most of the participants were students, and during this time the participants were asked to avoid physical activities outside the training program. All participants were informed about the possible risks of the experiment and their written consent was obtained to participate in the experiment. This study was approved by the Ethics Committee of Sakarya University of Applied Sciences (100/2184) and was performed in accordance with the Declaration of Helsinki International Standards for Human Research. All data were collected at the Campus Fit life gym in Sakarya.

Research Design

Resistance Training

The exercise program was applied 3 days a week for 6 weeks. There are 3 different groups in the study. A regional (split) program was applied to the groups in the form of chest on the first training day of the week, back on the second training day, and shoulders on the third training day. The resistance training program is given in Table 1. The MGVT method was applied to the first group. In this method, the first 2 movements of the training program were selected from compound exercises and 5 sets of 10 repetitions were applied, and additional exercises were added to these exercises. In the MGVT method, the rest period between sets was 90 seconds [2]. Superset method was applied to the second group. This method was applied one after the other without giving a rest period between 2 exercises for the same muscle group and the whole training program was applied in the same order. In the superset method, the rest period between sets was 60 seconds. Giant set method was applied to the third group. In this method, 4 exercises for the same muscle group were applied one after the other without resting between them. In the giant set method, a rest period of 60 seconds was applied between sets. In the study, training intensity was applied between 60% and 80% of the subjects' maximal weight. In the first week of the study, the training was started with 60% intensity and the principle of progressive overload was applied by increasing the intensity by 5% every week.

Total Training Volume

In order to equalize the training coverage of all participants, the same number of exercises, sets and repetitions were applied in total for a training session. Exercise intensity was applied between 60% and 80% of the participants' 1RM values, and the intensity was equalized.

Measurement

Table 1. Resistance Training Program

Variables	Set	Repetition	Resting, sec.	Exercise intensity, %
Modified German Volume Training				
1st Day				
Bench Press	5	10	90-120	60-80
Incline Bench Press	5	10	90-120	60-80
Decline D Press	3	12	90-120	60-80
Dumbbell fly	3	12	90-120	60-80
2nd Day				
Barbell Row	5	10	90-120	60-80
Lat Pull Down	5	10	90-120	60-80
Seated Row	3	12	90-120	60-80
Low Row	3	12	90-120	60-80
3rd Day				
Shoulder press	5	10	90-120	60-80
Dumbbell Front Raise	5	10	90-120	60-80
Lateral raise	3	12	90-120	60-80
Rear delt raise	3	12	90-120	60-80
Superset				
1st Day				
Bench Press	4	10	60	60-80
Dumbbell fly	4	10	60	60-80
Incline Bench Press	4	12	60	60-80
Decline Dumbbell Press	4	12	60	60-80
2nd Day				
Barbell Row	4	10	60	60-80
Low Row	4	10	60	60-80
Lat Pull Down	4	12	60	60-80
Seated Row	4	12	60	60-80
3rd Day				
Shoulder press	4	10	60	60-80
Dumbbell Lateral Raise	4	10	60	60-80
Dumbbell Front Raise	4	12	60	60-80
Rear Delt Raise	4	12	60	60-80
Giant set				
1st Day				
Bench Press	4	10	60	60-80
Incline Bench Press	4	10	60	60-80
Decline Dumbbell Press	4	12	60	60-80
Dumbbell Fly	4	12	60	60-80
2nd Day				
Barbell Row	4	10	60	60-80
Lat Pull Down	4	10	60	60-80
Seated Row	4	12	60	60-80
Low Row	4	12	60	60-80
3rd Day				
Shoulder Press	4	10	60	60-80
Dumbbell Front Raise	4	10	60	60-80
Lateral Raise	4	12	60	60-80
Rear Delt Raise	4	12	60	60-80

In order to measure the changes in chronic muscle strength and hypertrophy caused by the three different sets method we used in the study, 1RM strength, muscle CSA and muscle thickness measurements were made before and after the 6-week training period.

Body Composition

Height measurements of the participants were made only while wearing shorts, with their heads straight, knees bent, and body straight. Body mass and body mass index data were collected with the Tanita bioelectrical impedance instrument (Tanita, Body Composition Analyzer, BC-418) connected to the bioelectrical impedance method.

Maximal Strength Assessments

1RM test was taken in bench press, shoulder press, barbell row exercises in the 1-week period before starting the training program. While taking the measurements, the measurements of each exercise were taken on different days and with 1 day of rest between them.

Before 1RM strength tests the athletes performed a standard 10-minute warm-up protocol on the bicycle ergometer. Immediately after, they performed dynamic mobility exercises for the upper extremity muscles. While performing 1RM strength measurements, 1 retest protocol recommended by the American College of Sports Medicine (ACSM) was applied. First, 2 warm-up sets of light to moderate were applied. After the first set was performed 5-10 repetitions, 1 minute rest was given. The second set was performed 2-5 repetitions and 2 minutes of rest were given. With the third set, 1 repetition attempt was started and 2-4 minutes of rest was given. In the following sets, 5-10% load increase was continued with each successful lift and a rest period of 2-4 minutes was given. When an unsuccessful lift occurred, the load was reduced by 2.5-5% and the lift was performed again [16].

Muscle Thickness and Muscle CSA Measurements

An ultrasound device (TOSHIBA Aplio 400) was used to measure the muscle cross-sectional areas and muscle thickness of the subjects. Shown in figure 1. [17], stated in his study that the ultrasound method used for hypertrophy measurements is the gold standard. In the study, measurements of pectoralis major, deltoid and latissimus dorsi muscles were taken. Measurement of the Pectoralis Major muscle group was taken from the region between the third and fourth ribs below the midpoint of the clavicle. The deltoid muscle group was measured as one-fourth of the distance from the acromion to the lateral epicondyle. In the Latissimus Dorsi muscle group, measurements were taken from the lateral side of the scapula.

Statistical Analyses

3*2 Repeated Measures ANOVA was applied to compare the pre-test and post-test data of the variables according to the groups. SPSS.21 program was used in the analysis of the data.

Results

When examined the Table 2, it was determined that the averages of pec major thickness values in the pre-test and post-test showed a statistical difference ($p<0.05$). Accordingly, it was determined that the pec major thickness values increased between the pre-test and the post-test. In addition, it was determined that the pec major thickness values did not show a statistical difference according to the groups ($p>0.05$).

When examined the Table 3, it was determined that the averages of the deltoid thickness values in the pre-test and post-test showed a statistical difference ($p<0.05$). Accordingly, it was determined that the deltoid thickness values increased between the pre-test and the post-test. In addition, it was determined that the deltoid thickness values did not differ statistically according to the groups ($p>0.05$).

When examined the Table 4, it was determined that the averages of the latissimus thickness value in the pre-test and post-test showed a statistical difference ($p<0.05$). Accordingly, it was determined that the latissimus thickness values increased between the pre-test and the post-test. In addition, it

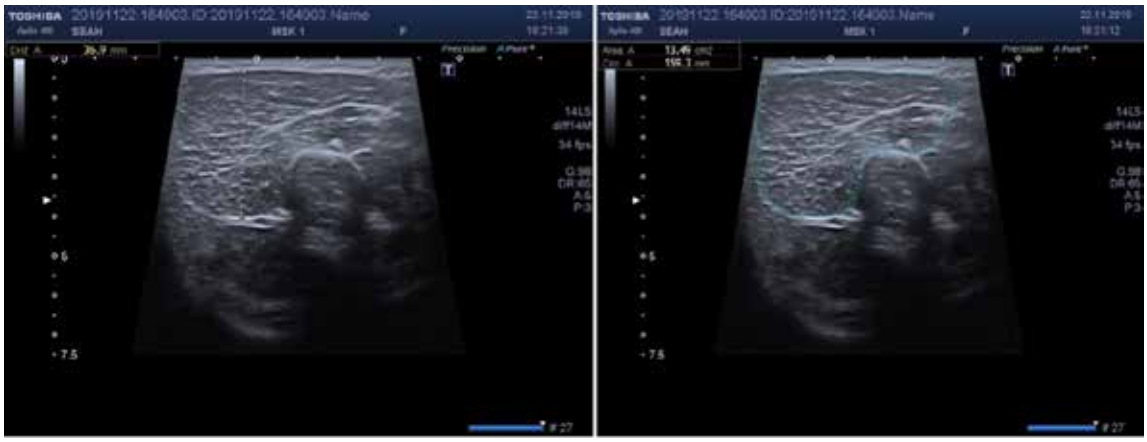

Figure 1. Muscle Thickness and CSA Measurements

was determined that the latissimus thickness values did not show a statistical difference according to the groups (p>0.05).

According to Table 5, it was determined that the averages of the pec major area values in the pre-test and post-test showed a statistical difference (p<0.05). Accordingly, it was determined that the pec major area values increased between the pre-test and the post-test. In addition, it was determined that the pec major area values did not differ statistically according to the groups. (p>0.05).

According to Table 6, it was determined that the averages of the deltoid area values in the pre-test and the post-test showed a statistical difference (p<0.05). Accordingly, it was determined that the deltoid area values increased between the pre-test and the post-test. In addition, it was determined that the deltoid area values did not differ statistically according to the groups. (p>0.05).

Considering Table 7, it was determined that the averages of the latissimus area value in the pre-test and the post-test showed a statistical difference (p<0.05). Accordingly, it was determined that the latissimus area values increased between

Table 2. Pre-test and post-test comparison of pec major thickness values of the groups

Variables	N	Pre-test	Post- test	F	p
		$\bar{X}$ ± SD	$\bar{X}$ ± SD		
Modified German Volume Training	11	2.60±0.49	3.51±0.57		
Super Set	11	2.15±0.49	3.10±0.52	2.262	0.123
Giant Set	9	2.49±0.56	3.70±0.98		
Total	31	2.41±0.56	3.42±0.72		
		F=112.510; p=0.001			

Table 3. Pre-test and post-test comparison of deltoid thickness values of the groups

Variables	N	Pre-test	Post- test	F	p
		$\bar{X}$ ± SD	$\bar{X}$ ± SD		
Modified German Volume Training	11	2.68±0.37	3.32±0.31		
Super Set	11	2.66±0.45	3.11±0.42	0.346	0.711
Giant Set	9	2.67±0.58	3.09±0.34		
Total	31	2.67±0.45	3.18±0.36		
		F=63.324; p=0.001			

Table 4. Pre-test and post-test comparison of latissimus dorsi thickness values of the groups

Variables	N	Pre-test	Post- test	F	p
		$\bar{X}$ ± SD	$\bar{X}$ ± SD		
Modified German Volume Training	11	4.19±1.10	4.58±1.06		
Super Set	11	3.77±0.88	4.21±0.88	0.566	0.574
Giant Set	9	3.87±0.80	4.40±0.85		
Total	31	3.95±0.93	4.40±0.92		
		F=12.005; p=0.002			

Table 5. Pre-test and post-test comparison of pec major area values of the groups

Variables	N	Pre-test	Post- test	F	p
		$\bar{X}$ ± SD	$\bar{X}$ ± SD		
Modified German Volume Training	11	12.34±2.63	19.51±2.77		
Super Set	11	10.28±2.93	17.38±2.42	1.463	0.249
Giant Set	9	12.10±3.83	20.20±7.41		
Total	31	11.54±3.16	18.95±4.55		
		F=128.860; p=0.001			

the pre-test and the post-test. In addition, it was determined that the latissimus area values did not show a statistical difference according to the groups (p>0.05).

Considering Table 8, it was determined that the averages of the pre-test and the post-test bench press values differed statistically (p<0.05). Accordingly, it was determined that the bench press values increased between the pre-test and the post-test. In addition, it was determined that bench press values did not differ statistically according to the groups (p>0.05). Also, it was revealed that the group*time interaction was statistically significant (F=4.383; p=0.022). Accordingly, it was determined that the increase in bench press values in the GS group was less than the increase in the bench press values of the other groups.

When examined the Table 9, it was determined that the averages of the barbell row value in the pre-test and post-test showed a statistical difference (p<0.05). Accordingly, it was determined that the barbell row values increased between the pre-test and the post-test. In addition, it was determined that the barbell row values did not differ statistically

Table 6. Pre-test and post-test comparison of deltoid area values of the groups

Variables	N	Pre-test	Post- test	F	p
		X̄ ± SD	X̄ ± SD		
Modified German Volume Training	11	14.61±3.10	16.15±1.71		
Super Set	11	13.29±2.28	15.92±2.68	0.380	0.687
Giant Set	9	14.54±2.38	15.60±2.18		
Total	31	14.12±2.61	15.91±2.16		
		F=15.246; p=0.001			

Table 7. Pre-test and post-test comparison of the latissimus area values of the groups

Variables	N	Pre-test	Post- test	F	p
		X̄ ± SD	X̄ ± SD		
Modified German Volume Training	11	19.61±4.36	22.94±5.77		
Super Set	11	17.26±4.45	22.95±7.12	0.210	0.812
Giant Set	9	17.03±3.51	23.24±5.92		
Total	31	18.03±4.20	23.03±6.11		
		F=32.527; p=0.001			

Table 8. Pre-test and post-test comparison of the bench press values of the groups

Variables	N	Pre-test	Post- test	F	p
		X̄ ± SD	X̄ ± SD		
Modified German Volume Training	11	0.98±0.28	1.28±0.26		
Super Set	11	0.88±0.21	1.17±0.20	1.252	0.302
Giant Set	9	0.88±0.20	1.08±0.24		
Total	31	0.91±0.23	1.28±0.24		
		F=308.172; p=0.001			

Table 9. Pre-test and post-test comparison of barbell row values of the groups

Variables	N	Pre-test	Post- test	F	p
		X̄ ± SD	X̄ ± SD		
Modified German Volume Training	11	1.10±0.27	1.35±0.27		
Super Set	11	1.04±0.18	1.30±0.17	0.744	0.485
Giant Set	9	1.03±0.26	1.15±0.31		
Total	31	1.06±0.23	1.28±0.26		
		F=241.897; p=0.001			

Table 10. Pre-test and post-test comparison of shoulder press values of the groups

Variables	N	Pre-test	Post- test	F	p
		$\bar{X}$ ± SD	$\bar{X}$ ± SD		
Modified German Volume Training	11	0.99±0.23	1.32±0.31		
Super Set	11	0.71±0.32	1.07±0.30	4.517	0.020
Giant Set	9	0.72±0.24	0.90±0.26		
Total	31	0.81±0.29	1.11±0.33		
		F=193.293; p=0.001			

according to the groups (p>0.05). Also, it was revealed that the group*time interaction was statistically significant (F=9.390; p=0.001). Accordingly, it was determined that the increase in barbell row values in the GS group was less than the increase in the barbell row values of the other groups.

When examined the Table 10, it was determined that the averages of the pre-test and post-test shoulder press values showed a statistical difference (p<0.05). Accordingly, it was determined that the shoulder press values increased between the pre-test and the post-test. In addition, it was determined that the shoulder press values differed statistically according to the groups (p<0.05). Accordingly, the average of the shoulder press values of the GS group is lower than the other groups. Also, the group*time interaction was statistically significant (F=6.520; p=0.005). Accordingly, it was determined that the increase in shoulder press values in the GS group was less than the increase in the shoulder press values of the other groups.

Discussions

In the study, the effects of MGVT, SS and GS methods on maximal strength, muscle thickness and CSA were examined in a 6-week training period. The study revealed several important findings. When these results were examined, a positive increase was detected in the 1RM strength, muscle thickness and CSA values of all groups in the six-week period. Although no difference was observed between the groups, the group*time interaction was found to be statistically significant in 1RM strength values. According to these values, it was determined that the GS group increased less than the MGVT and SS groups. In the hypothesis of the study, we expected more muscle strength and hypertrophy development in the group that applied the MGVT method, but according to the results, there was no difference between the three methods. When evaluated in general, it can be said that three sets method do not have advantages or disadvantages compared to each other for muscle strength and hypertrophy gain.

When the related studies are examined, it is seen that the training experience level of the participants is one of the main factors affecting the result of the study. In studies where the training level of the participants is high, it is seen that set methods reveal more positive developments than traditional resistance training. In this context Prestes et al. [18], compared rest pause and traditional training methods in athletes with good training levels. When the results are examined, it is seen that the rest pause method produces a greater increase in muscle hypertrophy compared to the traditional method. Similarly Bjørnsen et al. [19] compared Blood Flow Restriction and traditional training method in 17 powerlifter athletes competing on the national surface. According to the results, the Blood Flow Restriction method has produced more positive results in muscle hypertrophy. On the other hand, in the participants with low training levels, improvement was observed in all groups and there was no difference between the sets methods and the traditional method. However Ozaki et al. [20] and Fink et al. [21] compared the drop set and traditional methods in untrained individuals. According to the results, improvement was observed in all groups, but no difference was found between the groups. In this direction, when studies comparing more than one set method are examined, as in our research, positive developments are observed in all set methods in studies conducted with participants whose training background is not at a good level, but it is seen that no difference can be detected between the groups. Amirthalingam et al. [2] compared MGVT and GVT methods in his study. Although improvement was observed in both groups, no difference was found between the groups. Damas et al. [22] compared high and low training frequency on 20 untrained male participants. According to the results, positive increases were observed in both groups, but no difference was found between the two groups. Fink et al. [23] compared training with heavy and light loads in his study and similarly, no difference was found between the groups. These studies are similar to our study in terms of the duration of the training period, the characteristics of the participant group and the results they reveal, and support our findings. However, another important factor affecting the results of the studies is the length of the applied training period. In this direction, Amirthalingam et al. [2] and Hackett et al. [6] are two studies

examining the MGVT method. The characteristics of the participant groups of the studies are the same, and the only difference between the two studies is the length of the training period: six weeks [2] and twelve weeks [6]. When the duration of the training period increased to twelve weeks, it was determined that there was a difference between the sets methods. At the same time, there may be many parameters that may affect the outcome of the study. Some of those; rest time between sets, training frequency, exercise order, load amount and number of sets etc. When the studies with these parameters and with trained participants were examined, improvement was observed in all groups and differences were detected between the groups [17, 24, 25, 26, 27, 28].

As a result, this study has some limitations. The first of these is that the participant group of the research does not consist of well-trained individuals. As we mentioned in the literature, it is seen that different results can occur in studies with well-trained individuals. Second, the 6-week training period may not be optimal for assessing the extent of adaptation in muscle strength, thickness, and cross-sectional area parameters. At the same time, a previous study showed that biceps and triceps CSA increased after 6 weeks of resistance training (RT), with no significant improvement after 8 and 12 weeks compared to 6 weeks [29]. The third is that the total duration of the training, the rest intervals between sets and exercises are different from each other in the three methods. Due to these limitations, there may not have been a difference between the groups. In future research, different results can be obtained by using well trained individuals, longer training periods and different rest periods between sets.

Conclusions

The use of set methods in the development of strength and hypertrophy is an important criterion to increase efficiency. The results of this study reveal that there is no difference between the MGVT, SS and GS methods in the 1RM strength and hypertrophy development of young male individuals who do not have a history of resistance exercise but have completed the adaptation period, and that there is an improvement in all set methods. In order to better understand the effects of these set methods, studies with different sample groups, training periods and different technical applications are necessary.

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Conflict of İnterest

The authors declare no conflict of interest.

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