A Study of Moment Inertia and Its Effect on Angular Velocity When Performing Angular Motion around a Longitudinal Axis

Introduction:

The momentum of a rigid body is called as the multiplication of a product of moment of Inertia and also the Angular speed, it's similar to the linear momentum however when the subject is constrained to conservation of Angular momentum the principle shows there is no external torsion on the particular article. Angular Momentum is often the expression of momentum of a particular particle. In other view the Angular speed that is additionally known as the rotational velocity and might be outlined as quantity of rotation that a spinning object undergoes per unit of time. Momentum and angular speed each square measure vector quantities. (Landau, 1969)

Throgh moment of Inertia mass resistance is measured with rotational acceleration about one or more axes and it is defined as the distribution of the property of mass in a space. Linear motion of a body in the state of Inertia can be best described by Newton's first law and by using moment of inertia this is extended to the rotation of a body about an axis in the state of inertia. When external torque is applied if an object is rotating in a constant speed it will keep rotating. This is the evident that mass plays important role in linear dynamics and thus the inertia movement has the same role in rotational dynamics. Momentum of inertia describes the relationship between the angular of velocity and momentum and also includes the rotational and angular speed or acceleration.(Walker, 2005) Inertia can be described as the that is that the total of the product of the mass of every particle within the body with the sq. of its distance from the axis of rotation.

In an example of car rolling, when a car is rolled forward in a highway. The vectors of the angular velocity of all four tires move towards the left side with the lines containing the wheel axis. Position of vector depends upon the speed of the car. When car is in motion and speeds up vectors get longer and when car slowed down vector gets shorter and length of the vector become zero when car stops. Position of the Vectors revers changes the direction when the car is put on a reverse gear and the wheels moves toward the right with the lines containing the wheel axles.

In another example of gymnastics, Transitional skills are most important in aerobic movements on the, i.e. Aerobic moments includes Flic-Flac, round off here with various body positions the movements of backwards take off initiates the straight and rotational body position for somersaults, the body positions can be either linear or stretched. The most major point of the take-off that leads a stretched backward flip-flop on the floor it is the optimization of the related variables: i.e. to attain a big angular momentum's magnitude by the speed by achieving a good amount of kinetic energy is very important.

Study aimed at analyzing the relationship that exist between Moment of Inertia and angular velocity by when the angular momentum should be stable and when the body is doing a circulatory movement about its longitudinal axis.

Methods:

Participants:

This study comprises of 10 individuals without any specific anthropometric measurement, the test has been done in two different conditions.

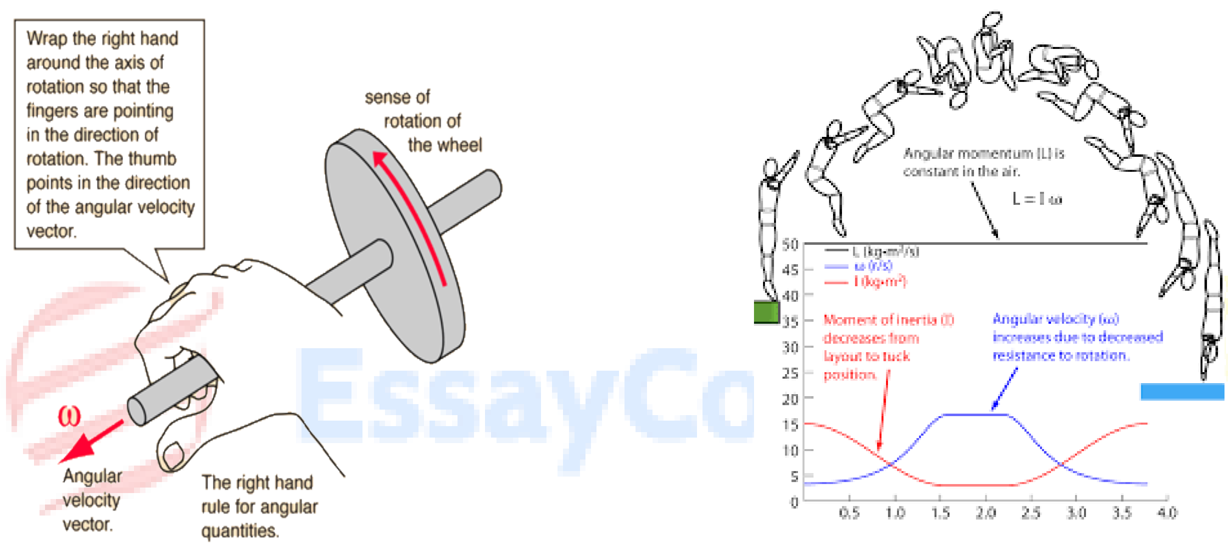

Fig: The diagram shows the Angular Momentum and Angular Velocity

Procedure:

Data Analysis:

The data analysis has shown the result of the angular momentum was found from the displacement of the angular with relation to time data. The t- test analysis was used to determine the significant difference in the study.

Results:

Calculations:

Table 1: Describes the steps followed in calculating Angular Velocity *w*

Formula:

Angular Velocity w = ϴ/T,

Description of formula:

ϴ - Describes the Angular displacement and

T - Is the amount of time taken.

Charecteristics	Calculations	
Time	T_a=3.8	T_b=1.98
Angular Displacement ϴ	360	360
Angular Velocity	$w_a = \Theta/T_a$; 360/3.8 =94.73	$w_b = \Theta/T_b$; 360/1.98 =181.8
Angular Velocity Ratio	W_b/W_a =181.8/94.73=1.92	= 1:1.92

Table 2: shows the data of w ratio which is collected from the participants with the mean and standard deviation.

Individual Value	ω Ratio
1	01:02.3
2	01:02.0
3	01:02.1
4	01:01.9
5	01:01.8
6	01:01.9
7	01:02.3
8	01:01.6
9	01:01.8
10	01:02.3
Mean and (SD)	1.90 ± (0.25)

Bar Graph For Angular Velocity Wa

Bar Graph For Angular Velocity Wb

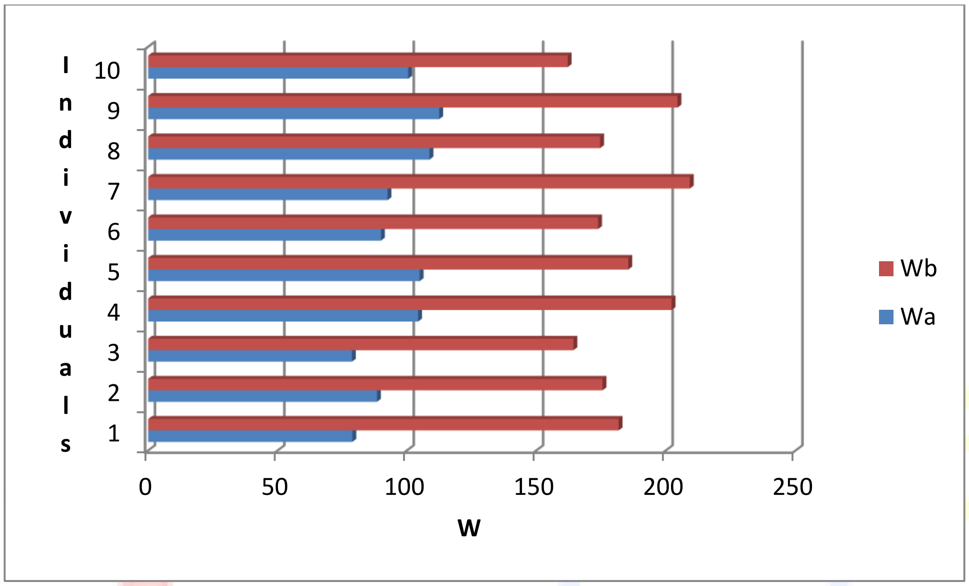

Figure 2: wa & wb Bar Chart

Chart presented above shows w recorded for 10 individuals when performing test in two different body positions. and there is sufficient evidence that there is significant difference between wa & wb

Paired t-Test:

Using Paired sample t test means of matched groups is compared belongs two two different population which are correlated with each other Paired Sample t test is used when the samples are in match pairs or in case of case-control studies.

Hypothesis:

The hypothesis for the study is Null Hypothesis that means,

H_0: There is no Significant relationship between the Angular Velocity from the Position a to b Position.

Test Statistics:

$$t = \frac{\Sigma d}{\sqrt{\frac{n\left(\Sigma d^2\right)-\left(\Sigma d\right)^2}{n-1}}}$$

Significance level: 5% (α = 0.05)

Rejection Criteria: Reject the null hypothesis if P<0.05

Paired Sample Statistics

Angular Velocity	Mean	N	SD	SE
Wa	96.00	10	11.935	3.774
Wb	183.50	10	16.748	5.296

$$t = \frac{874.42}{[(\sqrt{10} \times 78881.51 - (874.42)^2)/(10-1)]}$$

$$t = \frac{874.42}{[\sqrt{(788815.1 - 764610.3)/9}]}$$

$$t = \frac{874.42}{[\sqrt{2689.42}]}$$

$$t = \frac{874.42}{[51.82]}$$

$$t = 16.87$$

Conclusion:

There is sufficient evidence that There is Significant relationship between the Angular Velocity from the Position a to b Position. The t-value = 16.87 which is greater than 3.20 , t value for 5% level of significance. and hence $p<0.05$.

Discussion:

Mean ration between wa to wb is found to be 1.90 with standard deviation 0.25, paired t test is used to calculate significance of difference of angular velocity (w) at two time points ta and tb, and observations are matched observations. Paired t test result revealed that null hypothesis is rejected and there is sufficient evidence that angular velocity w for positin a to position b i.e wa and wb that is relatively different at 5 % to the level of significance ($P<0.05$).

References:

Walker, David Halliday, Robert Resnick, Jearl (2005). *Fundamentals of physics* (7th ed.). Hoboken, NJ: Wiley. ISBN 9780471216438.

L. D. Landau and E. M. Lifshitz, Mechanics, Vol 1. 2nd Ed., Pergamon Press, 1969.

Appendix: A

Time		Angular Velocity		D	D^2
Ta	Tb	Wa	Wb		
4.56	1.98	78.95	181.82	102.87	10582.24
4.07	2.05	88.45	175.61	87.16	7596.866
4.57	2.19	78.77	164.38	85.61	7329.072
3.45	1.78	104.35	202.25	97.9	9584.41
3.43	1.94	104.96	185.57	80.61	6497.972
4.00	2.07	90	173.91	83.91	7040.888
3.89	1.72	92.54	209.30	116.76	13632.9
3.31	2.06	108.76	174.71	65.95	4349.403
3.20	1.76	112.50	204.55	92.05	8473.203
3.58	2.22	100.56	162.16	61.6	3794.56

Appendix: B

SPSS results for paired t test:

Paired Sample Statistics

Angular Velocity	Mean	N	SD	SE
Wa	96.00	10	11.935	3.774
Wb	183.50	10	16.748	5.296

Correlations:

Angular Velocity	N	Correlation	Sig
Wa &Wb	10	0.386	0.271

Paired Sample Test:

Paired Differences					T	DF	Sig
Mean	SD	SE	95% CI				
			Lower	Upper			
-87.50	16.40	5.2	-99.28	-75.78	-16.88	9	0.000