

# A Study to Determine the Variation in Handwriting between Natural Pen Hold and Unaccustomed Pen Hold



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## Abstract

Handwriting is a neuro-muscular activity and is individualistic in nature. The ability of hand in creating the writing involves complex mechanism of the combined movement of fingers, thumb and hand which is controlled by the timed neural response system. Pen hold is the manner in which pen is held by an individual and also acts as one of the habitual characteristic features. Unaccustomed pen hold refers to the manner in which the pen is held by an individual is not seasoned with. This study was conducted to determine the variation in handwriting between natural pen hold and unaccustomed pen hold. To achieve the desired objective, the class characteristics were determined for both natural and unaccustomed pen hold samples. The Statistical Package for Social Sciences (SPSS) software was used to run the Independent Sample T-Test for the obtained raw data. On analysis, it was found that, line quality and tremor showed significant difference in handwriting between natural and unaccustomed pen hold samples. But characteristics such as alignment, spacing, slant, pen pressure, baseline, hesitation and size showed no significant difference in handwriting between natural as well as unaccustomed pen hold samples and therefore would asses in data analysis.

**Keywords:** Handwriting; Pen hold; Natural Pen Hold; Unaccustomed Pen Hold; SPSS Software

## Introduction

In this modern era, handwriting skills are being misused for fraudulent activities. On the same context, this study was conducted to determine whether there is variation in handwriting between natural pen hold and unaccustomed pen hold. The study assumes that, by determining the variation in handwriting between natural pen hold and unaccustomed pen hold, would narrow down the analysis and therefore subsides the fraudulent activities. Types of pen hold includes:

- A. Radial cross palmar grasp
- B. Palmar supinate grasp
- C. Digital pronate grasp, only index finger extended
- D. Brush grasp
- E. Grasp with extended fingers
- F. Cross thumb grasp
- G. Static tripod grasp
- H. Four fingers grasp

- I. Lateral tripod grasp
- J. Dynamic tripod grasp

This study was conducted to monitor the sEMG activity of trapezius, biceps brachii, extensor carpi radialis brevis and flexor digitorum superficialis during a handwriting task within two groups of subjects using two different grasp (Dynamic Tripod grasp and Static Tripod grasp) [1]. To experiment the study, 24 university students (13-males, 11-females; mean age of 22.04 ±2.8 years) were considered as subjects. Random invites were given for 12 subjects who used Dynamic Tripod grasp and 12 subjects for Static Tripod grasp. Significant statistical difference in sEMG activity of trapezium and biceps brachii muscles were seen among subjects using Static Tripod grasp during handwriting than when compared with Dynamic Tripod grasp subjects. No significant differences were seen in extensor carpi radialis brevis and flexor digitorum superficialis activities among the two groups. Study's findings suggests that, there is an increased activity of proximal muscles among subjects using transitional grasp, which indicates potential higher energy expenditure and muscular harm in handwriting task.

This study investigated the impact of common pencil grasp patterns on the speed and legibility of handwriting after a 10-minute copy task. Also intended to induce muscle fatigue, in typically developing children and among those who were non-proficient in handwriting [2]. 120 grade 4 students were considered to be the subjects and all were asked to complete the standardized handwriting assessment before and after a 10-minute copy task. It was found that students perceived difficulty of the handwriting task at baseline and after 10-minutes. They were also asked to complete a self-report questionnaire pertaining to their handwriting proficiency upon completion. On analysis it was observed that, majority of student's rated higher effort after 10-minute copy task than at baseline. The efforts ratings were found to be similar for the different grasp patterns. In both typically developing children and those with handwriting issues, it was found that, the legibility of the writing samples decreased after 10-minute copy task wherein the speed of writing increased. There were no significant difference in quality or speed values among the different pencil grasps before and after copy task. The dynamic tripod grasp, the lateral

tripod grasp and the dynamic or lateral quadrupod pencil grasps, all four patterns had equivalent performance level.

This study was conducted to determine whether the speed and legibility of fourth- grader's handwriting was affected by type of pencil grip on the evaluation tool of children's handwriting-cursive [3]. Evaluation tool of children's handwriting-cursive (ETCH-C) was completed by 95 typically developing students and 6 students receiving special education services. Photographs of pencil grips of the subjects were taken as and when they wrote the alphabets. One-way ANOVAs were used to determine the legibility rates and writing speeds by the type of pencil grip. On analysis it was found that, 99 subjects used one of four pencil grips, dynamic tripod (38 students), dynamic quadrupod (18 students), the lateral tripod (22 students) and lateral quadrupod (21 students). Four- finger pencil grip was used by one student and another student used inter digital pencil grip. Mean value for cursive writing speeds were similar for all pencil grips except for the inter digital grasp. Speed was slower compared to that of fourth- grade speeds ranging from a mean of 29.45 to 34.75 letters per minute. The study found that the lateral quadrupod and four-finger pencil grips were functional as that of the dynamic tripod, lateral tripod and dynamic quadrupod pencil grips. Fourth grade students showed average handwriting speed on ETCH-C.

This study was conducted to determine whether writing tool type and angle of writing surface affect grasp [4]. To achieve the desired objective, 51 children 23-24 months of age were considered as subjects. They were children's who typically drew with primary marker, colored pencil and a small piece of crayon on a table. The order of presenting the writing tools were counterbalanced. Their respective grasps were scored with a 5-point rating system and analyzed with dependent t-tests. On analysis it was found that, children used mature grasp while

drawing with a piece of crayon than with a pencil. There was no significant difference found in grasp maturity when using a pencil compared with a marker. The study concludes that a short writing tool combined with a vertical surface could influence the grasp of young children. This study was conducted to examine the influence of pencil grasp on handwriting legibility in both short and long writing tasks among 46 fourth - grade students [5]. During the study, the word and letter legibility were scored in regular classroom writing assignments and those scores were compared using a mixed repeated- measures analysis of variance design. Pencil grasp (dynamic grasp vs. atypical grasp) and task length were considered as the two independent variables. It was found that there was a significant difference between the letter legibility scores on the short task and the letter legibility scores on the long task. Among both the grasp conditions, subject's legibility score was lesser on the long task than on the short task. It was also found that there was no significant difference in scores between students those who used dynamic tripod grasps and those who used atypical grasps, nor there was an interaction between grasp and task length. Significant difference was also not seen between word legibility scores. The study states that the type of grasp does not affect the legibility.

This study was conducted to determine the joint laxity in the index finger and thumb and its relationship to pencil grasps used by children. 55 Australian 7- years old children were considered as subjects and their pencil grasps were analyzed to determine if joint laxity in the distal interphalangeal joint of the index finger and the interphalangeal joint and metacarpophalangeal joint of the thumb had an influence on the development of grasps which deviated from the dynamic tripod grasp [6]. Torque range of motion was used to determine the laxity and the pencil grasp was descriptively analyzed during the 3 writing tasks. 71% of the children showed laxity in at least one joint. Four types of pencil grasps were identified depending on the position of the thumb and the number of digits on the pencil shaft. The influence of interphalangeal joint of the thumb had no significant influence on the pencil grasps being used.

This study was conducted to investigate the relationship between handwriting style and speed and legibility. Examiner collected 3 writing samples (expository, narrative and copying) from 600 students in grades 4-9. All the writing samples scored for handwriting style and legibility [7]. Measure of handwriting speed was done with copied sample. The handwriting of subjects who had used mixed style was faster than the individuals who used exclusively one of the styles. Mixed style writing additionally received better rating for legibility than the other styles. Manuscript and cursive didn't show many differences in terms of legibility or speed.

This study examined the developmental progression in pencil and crayon grip. For this particular study, 320 non-dysfunctional children aged 3.0 to 6.11 years were considered as subjects, with 20 boys and 20 girls at each 6-month age interval. During the study, type of grips used by each child to perform a drawing

task and a coloring task were recorded [8]. The developmental progression was depicted by the percentage change of children at each age level among who used mature grips. 48% among the youngest used mature grips, compared with 90% of the oldest children. Dynamic and lateral tripod was found to be the most common two pencil grips. Significant difference in the developmental progression of pencil grip between boys and girls and between a drawing task and a coloring task were determined and noted. This study was investigated on the effects of pencil grip on handwriting speed and legibility. Dynamic tripod was considered as a standard pencil grasp and variations were examined with respect to their influence on the handwriting speed and legibility [9]. 282 children with in the age group of 8-14 years were considered as subjects. It was found that there was no significant difference in speed as well as legibility. On comparative study with standard versus non-standard grips and fast, legible versus slow, it was found that illegible writings had no influence on the type of grip employed and suggested that more research need to be focused on other factors underlying poor handwriting performance.

This study was done to analyze the pen holds of pupils of 7-15 years. During the study several significant findings were revealed. Pen hold's among school children show two main differences. One of the difference was that 60% of children, the distal interphalangeal joint of the index finger was hyper extended, which suggested that majority of children held their pen tightly [10]. Another difference was the number of children (65%) wrote with their thumbs closest to the pen tip. Evolution of grip with age revealed that: middle finger less often on the top and index finger less often on the side. It was found that child writing with an unconventional pen hold would not necessarily perform better to adopt a more conventional grip. This study was conducted to determine the qualitative changes in dynamic tripod grip between 7-14 years of age [11]. During the study, dynamic tripod grip was examined in handwriting among the subjects. The study measured four components which includes,

- A. Degree of index finger flexion,
- B. Degree of forearm pronation,
- C. Number of fingers used on the pencil shaft and
- D. Thumb and forefinger opposition.
- E. The measures (a) and (b) revealed the developmental trends which suggested the refinement of dynamic tripod with age.

able 2: Showing Class Characteristics with Its Mean Value.

Group Statistics						
	Pen Hold	N	Mean	Std. Deviation	t value	Significance
	Natural	100	2.19	1.228		
Alignment					-0.45	0.653

Materials and Methods

Requirements: A4 sheets (70 GSM), consent form, writing instrument (cello - pinpoint), pencil, ruler, and stereomicroscope.

Subjects

Age Group: Between 20 - 35 years. Category: Both males and females. Sample size: 100

Procedure: Individuals between the age group 20-35 years were considered as subjects for this particular study. The required consent form with authorization were taken prior data collection. The subjects were made to sit in a comfortable position. They were provided with 3 A4 sheets and a writing instrument. A small paragraph was given, and they were asked to write in their natural pen hold in 2 sheets (as exemplars) and in an unaccustomed pen hold of their choice in another sheet. The same procedure was repeated for all the 100 samples.

Analysis: The exemplars and unaccustomed pen hold writings were analyzed for the class characteristics such as alignment, spacing, line quality, slant, pen pressure, baseline, hesitations, tremor and size. The mean value for all the class characteristics with respect to both natural pen hold and unaccustomed Pen hold were obtained. The Statistical Package for Social Sciences (SPSS) software was used to run the Independent Sample T-Test for the obtained raw data to determine whether there were significant difference in handwriting between natural pen hold and unaccustomed pen hold. The obtained statistical values for independent sample T- test were tabulated and interpreted appropriately (Tables 1 & 2).

Table 1: Showing Class Characteristics with Its Mean Value.

Discriptive Status		
Variables	N	Mean
Pen Hold	200	1.5
Alignment	200	2.23
Spacing	200	1.785
Line Quality	200	1.295
Slant	200	2.355
Pen Pressure	200	1.29
Base Line	200	2.265
Hesitations	200	1.005
Tremor	200	1.085
Size	200	1.905

	Unaccustomed	100	2.27	1.285		
	Natural	100	1.75	0.435		
Spacing					-1.203	0.23
	Unaccustomed	100	1.82	0.386		
	Natural	100	1.01	0.1		
Line Quality					-8.614	0
	Unaccustomed	100	1.58	0.654		
	Natural	100	2.37	0.895		
Slant					0.236	0.813
	Unaccustomed	100	2.34	0.901		
	Natural	100	1.31	0.563		
Pen Pressure					0.518	0.605
	Unaccustomed	100	1.27	0.529		
	Natural	100	2.21	1.225		
Base Line					-0.619	0.536
	Unaccustomed	100	2.32	1.286		
	Natural	100	1	0		
Hesitations					-1	0.32
	Unaccustomed	100	1.01	0.1		
	Natural	100	1.01	0.1		
Tremor					-3.929	0
	Unaccustomed	100	1.16	0.368		
	Natural	100	1.91	0.287		
Size					0.24	0.81
	Unaccustomed	100	1.9	0.301		

## Result and Discussion

This study was carried out to determine the variation in handwriting between natural pen hold and unaccustomed pen hold. To achieve the desired objective, the class characteristics were determined for both natural and unaccustomed pen hold samples. The Statistical Package for Social Sciences (SPSS) software was used to run the Independent Sample T-Test for the obtained raw data. The mean value for class characteristics such as alignment, spacing, line quality, slant, pen pressure, baseline, hesitations, tremor and size with respect to both natural pen hold and unaccustomed Pen hold, were found to be 2.23, 1.78, 1.29, 2.35, 1.29, 2.26, 1.00, 1.08 and 1.90 respectively.

The t-test values for line quality and tremor were found to be 8.614 and 3.929 respectively which were above the table value at 0.05 significant value and indicates that there were significant difference in handwriting between natural pen hold and unaccustomed pen hold. Therefore, these class characteristics would assess the examiner and narrow down the analysis. The t-test values for alignment, spacing, slant, pen pressure, baseline, hesitation, and size were found to be 0.450, 1.203, 0.236, 0.518, 0.619, 1 and 0.240 respectively which were below the table value at 0.05 significant level and indicates that there were no significant difference in handwriting between natural pen hold and unaccustomed pen hold (Figures 1 & 2).

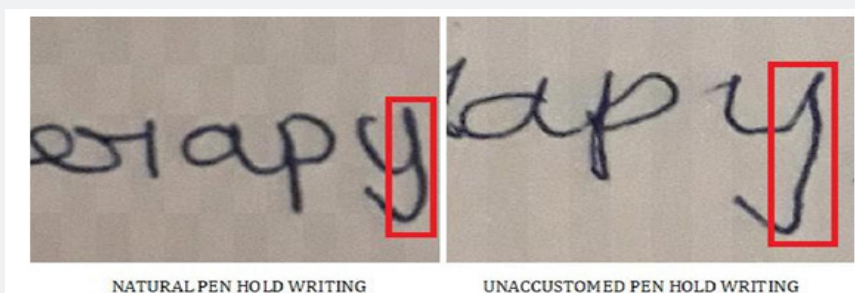


Figure 1: Showing Significant Difference In Handwriting Between Natural Pen Hold and Unaccustomed Pen Hold- With Respect to "TREMOR".



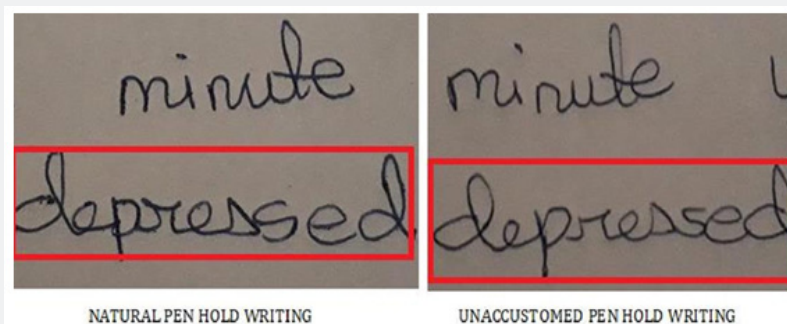


Figure 2: Showing Significant Difference in Handwriting Between Natural Pen Hold and Unaccustomed Pen Hold- With Respect to "SIZE".

### Conclusion

The study concludes stating that, line quality and tremor showed significant difference in handwriting between natural and unaccustomed pen hold samples. But characteristics such as alignment, spacing, slant, pen pressure, baseline, hesitation and size showed no significant difference in handwriting between natural and unaccustomed pen hold samples.

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