WHAT ARE THE DRAWING PROCESSES AND PRODUCT CHARACTERISTICS OF CHILDREN WITH DRAWING DIFFICULTIES?

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Abstract

Background: Drawing experience is a central graphomotor activity in preschool and may contribute to children's future handwriting performance in school.

Aims: To analyze and compare the drawing processes and product characteristics of children with and without drawing difficulties.

Methods: Participants were 51 children aged four to six years, 26 with drawing difficulties and 25 controls without drawing difficulties, as defined by their teacher's' reports. The children performed three standardized drawing tasks on paper placed on a digital tablet that collected objective data of the drawing process. Their drawn product was scored according to standardized scoring procedures.

Results: Children with drawing difficulties achieved significantly lower drawing product scores than did the controls. Significant differences were found in the drawing process measures (number of strokes, width of pen strokes on paper, and mean pen pressure). The drawing process outcomes significantly correlated with the final product scores in two of the three drawing tasks. Discriminant function analysis correctly grouped 80% of the children based on their drawing process and product measures/scores.

Conclusions: Combining the dynamic characteristics and product scores of children's drawing is effective in assessing children with drawing difficulties. Specifically, the Stars and Waves Test is a sensitive and effective test for identifying these children.

Keywords: *drawing difficulties, drawing process, drawing product, assessment, children*

1. INTRODUCTION

Drawing is a widespread occupation of children in preschool. While drawing, children explore, solve problems and visually present their ideas and emotional states that they cannot yet express verbally or in writing [1–2]. Therefore, drawing skills are crucial for their functioning in preschool and essential for their development in various areas, including motor, intellectual, emotional and social development [3–5]. The development of drawing skills is a universal, continuous and consistent process [6]. However, personal differences are evident and usually determined as a result of the interaction among factors such as environmental, biomechanical, cognitive and emotional factors [7–10].

Normally, universal age-related developmental changes transform children's drawing throughout childhood [11]. Drawing develops from spontaneous scribbling and gradually evolves to more organized scribbling that includes a variety of shapes, colors and sizes. Descriptive drawing begins around the age of three and a half years, when the child represents objects with shapes that express their character, and basic figures begin to appear. At age four and a half years, the schematic stage begins, and a fundamental change occurs in the way the child can represent spatial relations between drawn objects [12–13]. These stages provide knowledge about what to expect at different ages and what drawing tasks are suitable for assessing the children's level of drawing.

Various norm-based assessments are used to classify children according to their drawing products; for example, the Goodenough-Harris Draw-a-Person (DAP) Test [14], Beery-Buktenica Developmental Test of Visual–Motor Integration [15] and Draw-a-Person Intellectual Ability (DAP:IQ) Test [16]. These various drawing tests that are based on developmental stages measure the final graphic product.

In recent years, growing research has viewed drawing as a dynamic process and focused on the how the child draws while considering factors such as speed, length of time the pen is in-air and amount of pressure on the pen [17–18]. However, results of these studies are inconclusive and predominantly focus on specific populations, such as children with attention deficit hyperactivity disorder, learning disabilities and developmental coordination disorder (DCD).

Handwriting is a activity similar to drawing that involves both visuomotor and motor skills to produce a graphic product [18]. The use of drawing for assessment is a powerful tool because drawing tests are less intimidating, easier, quicker and more pleasant than more structured assessments [19]. Drawing an image of a person is a common and familiar task among children and drawing a person is extensively used for evaluating children's intellectual and cognitive level [16]. Development of drawing skills involves both spontaneous drawing and graphic copying [7]. As children's cognitive and emotional skills and their visomotor integration abilities develop, their drawing become more complex and detail rich while considering spatial relationships among the components of the drawing [7,20].

Furthermore, many researchers have found drawing to be a useful tool for predicting academic achievement and the characteristic skill of the child's developmental level, such as reading, spelling (accuracy and speed) and writing [19,21–24]. Moreover, because developmentally drawing precedes writing, investigating the characteristics of children with difficulties in drawing may enrich the knowledge about the cause of the difficulty and assist in developing a prevention program.

Handwriting or drawing process characteristics can be evaluated using the Computerized Penmanship Evaluation Tool (ComPET), a computerized system that provides measurable and objective information. This allows researchers to track the dynamic process that occurs in real time while performing the graphic activity [25–26]. Handwriting studies displayed significant differences in process outcome measures of children with and without difficulties in writing, such as the size of the letters [24], pressure on the pen [5,27], time in-air between written strokes [28] and writing speed [29]. Nevertheless, most studies that focused on analyzing the performance process used this technology to examine handwriting; only few focused on drawings.

Therefore, the aim of this study was to compare characteristics of the actual drawing process of children with and without drawing difficulties, to examine the relationship between the final product measures of various drawing tasks and their process measures, and to determine which characteristics predict the drawing difficulty in the best way.

2. MATERIALS AND METHODS

2.1. Participants

Children aged four to six years were recruited from seven mainstream preschools. Children with physical or neurological deficits were excluded. The children were divided into two groups: children with drawing difficulties (DD; $n = 26$; $M = 64.46$ months; $SD = 3.94$) and children with no drawing difficulties (NDD; $n = 25$; $M = 65.76$ months; SD = 4.51).

2.2. Instruments

2.2.1. Demographic questionnaire

Parents completed a 26-item demographic questionnaire (e.g., age, gender, religious background, health and developmental status, hand dominance, language spoken at home and parents' education level).

2.2.2. Drawing Proficiency Screening Questionnaire (DPSQ)

The DPSQ [18] is a 10-item questionnaire tool for identifying difficulties in drawing among children in preschool aged three to six years. The DPSQ is composed of three domains related to drawing skills: accuracy and effort, time and speed of performance, and the child's physical and emotional wellbeing. The preschool teacher rates each item on a scale of 0 (never) to 4 (always). A total mean score of the 10 items is calculated, with a higher score representing poorer functioning. The DPSQ was found to be a valid and reliable questionnaire; its mean score of 0.43 with standard deviation of 0.35 has been previously established among children with typical development [18]. In the current study, high reliability was found for the DPSQ (Cronbach α= 0.87), and children who obtained one standard deviation above the mean score were categorized as having difficulty in drawing.

2.2.3. Draw-a-Person Intellectual Ability Test (DAP:IQ)

The DAP:IQ [16] is a reliable screening tool for ages 4 to 89 years. Participants are asked to draw a picture of themselves that includes their entire body from the front. The DAP:IQ consists of 23 standardized criteria for scoring body parts, clothes and accessories. Each criterion is scored from 0 to 1, 0 to 2, 0 to 3, or 0 to 4 according to the specific item being scored. The total score is summed into a raw score that is converted to standardized age-norm-based IQ scores (M = 100, SD = 15) and t scores [16,30].

2.2.4. The Star Wave Test (SWT)

The SWT [31] is a short test that identifies signs of deficits in psychomotor readiness of children from three years of age. Different aspects of drawing, such as motor functioning, perception and school readiness, are examined. The drawing is performed on a standard form sheet inside a graphic frame. The child receives a short instruction: 'Draw a starry sky over the ocean waves'. The total score ranges from zero to 10 points according to five criteria: (a) task understanding, (b) form of the stars, (c) motion of the waves, (d) spatial arrangement and (e) frame recognition. The test is sensitive to school readiness and visumotor skills, as well as attention, motivation, inhibition, initiation, planning and organization in time and space [32]. Convergent validity was established between the SWT and the Child Evaluation Checklist, designed to identify children with developmental delays [Rosenblum, Ezra Zandani, Deutsch-Castel & Meyer, submitted for publication].

2.2.5. Complex Figure (CF) Test adapted for young children

The CF test was originally developed by Rey [33], and a simple version later adapted for clinical and educational use among young children [34]. The main objective of the CF is to assess a children's ability to form and use strategies that will assist them when confronted with a complex task. The test is composed of five stages, including copying, memory, mediation, second copying and second memory. In the current study, only the first stage—during which the child is asked to copy a complex geometric figure onto a rectangular page—was administered. The shape consisted of 11 elements (lines and basic shapes), each given one point for accuracy and one point for location. Thus, a total of 22 points can be achieved [35].

2.2.6. Computerized Penmanship Evaluation (ComPET)

All three drawing tasks (described in 2.2.3–2.2.5) were performed on a sheet of paper affixed to a digitizer table that was part of the ComPET [25,28]. The ComPET is a non-language dependent, standardized and validated system for assessing handwriting or drawing-process characteristics. The system includes a digitizing tablet and online data collection and analysis software (WACOM Intuos 4). The digitizer is accompanied by a wireless electronic pen with a pressure-sensitive tip (model GP-110). The pen is similar in size and weight to regular pens commonly used by children and thus does not require a change in grip that might affect their writing performance. The system collects objective information about the time, space and pressure of the drawing. Temporal measures include total time of performance, on-paper time and in-air time. Spatial measures include total stroke height for marks on the paper and mean stroke height on-paper and in-air.

2.3. Procedure

The study was approved by the institutional ethics committee and the Head Scientist Office of the Israel Ministry of Education. Data were collected at seven mainstream preschools and a local community center. The teachers chose children with difficulty in drawing and obtained signed consent from the parents. The teacher completed the DPSQ [18]. The children were divided into two groups: DD (n = 26) and NDD (n = 25) based on the DPSQ. The three drawing tasks were individually administered to the children on the ComPET at their preschool or in a quiet room at the local community center in the following order: (1) DAP: IQ, (2) SWT on a 22-by-14 cm sheet in order to adapt to the electronic tablet and (3) CF adapted to young children.

2.4. Data analysis

Data were analyzed using IBM SPSS Statistics (version 2). The *t*-tests for non-dependent variables were used to compare product scores of the three drawing tasks, with significance level set at .05. A MANOVA was performed to test for group differences in the drawing process measures (temporal, spatial and pressure), as measured by the ComPET. Pearson's correlation was calculated to test correlations between process measures (temporal, spatial and pressure) as measured by the ComPET and between the process measures and the product score in the three tasks. Discriminant analysis was conducted to examine which drawing characteristics best predicted the group affiliation of the participants in the two groups (with and without difficulties in drawing).

3. RESULTS

3.1. Demographics

Fifty-one children (26 boys and 25 girls) participated in the study. The children were recruited in seven mainstream preschools (60% kindergarten, ages 5–6 years; 39% pre-kindergarten, ages 4–5 years). Children with physical or neurological deficits were excluded. All the children were Arabic speaking, Muslim and born in Israel. Most (98%) of the children were born following a normal pregnancy and birth and all were generally healthy. No significant differences were found between the two groups in the children's ages ($t(49) = -1.096$, $p = .297$) or mothers' years of education (DD group: $M = 15.08$; NDD group: $M = 16.12$ yr; $t(49) = -1.77$, $p > .050$). As presented in Table 1, at least 72% of the children in each group drew every day or two to three times a week. Additional demographic characteristics are presented in Table 1.

Table 1. Comparison of demographic variables between the two groups

Variable	DD (n = 26)	NDD (n = 25)	χ^2	p
Gender				
Boys	53.8%	48%	0.170	0.676
Girls	46.2%	52%		
Hand dominance				
Right	96.2%	96%	0.001	0.977
Left	3.8%	4%		
Frequency of drawing at home				
Everyday	34.6%	36%	3.540	0.302
2–3 times/week	38.5%	56%		
< once a week	23.1%	8%		
Not at all	3.8%	0		

Note: DD = Group with drawing difficulties; NDD = Group with no drawing difficulties

3.2. Group differences in DPSQ scores

The children were divided into two groups based on the DPSQ scores completed by the preschool teachers to identify drawing efficiency. As expected, a significant difference was found in the total DPSQ score between the two groups ($F_{(10,40)}$= .290, p < .001, η^2_P = .710). Following ANOVA analysis defined that the source of the difference were the differences in all the items scores, as presented in Table 2.

Table 2. Means, standard deviation and *F* values of the DPSQ items in both groups

		DD (n = 26)	NDD (n = 25)		
	DPSQ item	*M* (*SD*)	*M* (*SD*)	$F_{(1,49)}$	(η^2_p)
1	Are the child's drawings unrecognizable?	1.19 (1.20)	0.04 (0.20)	16.92	.31***
2	Does the child ask for help when drawing or coloring?	1.50 (1.11)	0.32 (0.56)	17.75	.32***
3	Does the child rush when coloring or drawing?	2.38 (1.17)	1.00 (1.38)	24.43	.23***
4	Are there times when the child does not have enough time to finish drawing tasks?	2.00 (0.94)	0.60 (0.91)	24.98	.37***
5	Does the child hold the drawing tool tightly or with a fisted grasp?	1.23 (1.24)	0.12 (0.44)	15.73	.27***
6	Does the child complain of pain while drawing or coloring?	1.38 (1.33)	0.04 (0.02)	23.04	.34***
7	Does the child tire while drawing or coloring	1.38 (1.24)	0.28 (0.54)	15.55	.27***
8	Does the child not want to do his or her schoolwork if it requires drawing or coloring?	1.00 (1.10)	0.20 (0.50)	20.28	.36***
9	Does the child often tear the paper when coloring or drawing?	1.92 (1.29)	0.48 (0.82)	26.54	.31***
10	Does the child express feelings of dissatisfaction with his or her drawings or coloring?	0.85 (1.12)	0.04 (0.20)	8.28	.20**

Note: DPSQ = Drawing Proficiency Screening Questionnaire; DD = Group with drawing difficulties; NDD = Group with no drawing difficulties

**p < 0.010; ***p < 0.001

3.3. Group differences in drawing task product scores

A significant difference was found between the groups in the product score of the three tasks. As presented in Table 3, the DD group obtained significantly poorer scores than did the NDD group.

Table 3. Means, standard deviations and *t* value of product score of the drawing tasks in the two groups

	DD (*n* = 26)	NDD (*n* = 25)		
Variable	*M* (*SD*)	*M* (*SD*)	*t*(49)	*p*
DAP	49.62 (8.93)	57.08 (5.85)	-3.55	.001
SWT	4.85 (2.53)	7.88 (1.56)	-5.18	***
CF	2.64 (3.51)	11.08 (4.76)	-7.08	***

Note: DD = Group with drawing difficulties; NDD = Group with no drawing difficulties; DAP = Draw-a-Person test, SWT = Stars and Waves test, CF = Complex Figure test

***$p < 0.001$

3.4 Group differences in drawing process measures (temporal, spatial and pressure)

The MANOVA analyses for group differences exhibited a significant difference between the two groups ($F_{(4,41)} = .74$; $\Lambda = .86$, $p = .01$ $\eta^2_p = .26$). Following ANOVAs indicated that the source of the difference in both the DAP task and the CF task was the greater number of pen stokes found in the NDD group (Table 4). A significant difference was also found in the width of the drawing stroke ($F_{(4,42)} = .78$, $\Lambda = .77$, $p = .028$, $\eta^2_p = .22$). Following ANOVAs showed that the source of the difference was the higher width of the stroke in the DAP task among children with DD and higher width of the stroke among the children with NDD in the SWT (Table 4). In addition, a significant difference was found between the groups in the amount of pressure on the pen while drawing ($F_{(4,41)} = .63$, $\Lambda = .63$ $p = .001$, $\eta^2_p = .37$), and following ANOVAs revealed the source of this difference was in both the SWT and the CF (Table 4).

Significant differences were found in the process measures of the two groups. Specifically, a significant difference was found in the pen in-air measure while performing the DAP task ($t_{(31,35)} = 2.72$, $p = 0.01$). In this task, the children with DD spent more time with their pen in the air ($M = 2.02$, $SD = 1.11$) between each drawing stroke than did the children with NDD ($M = 1.37$, $SD = 0.44$). Another difference was found in the length of the stroke on the paper while performing the CF task ($t_{(45)} = -2.52$, $p = 0.02$). The length of the stroke on paper was significantly smaller among the DD group ($M = 45.92$, $SD = 32.88$) compared to children with NDD ($M = 68.68$, $SD = 29.11$).

Table 4. Means, standard deviations and *F* value of the process measures of the drawing tasks in the two groups

	DD (*n* = 26)	NDD (*n* = 25)		
Drawing task	*M* (*SD*)	*M* (*SD*)	$F_{(1,44)}$ (η^2_p)	*p*
Number of strokes				
DAP	43.64 (21.35)	61.42 (32.97)	4.62 (.10)	.037
SWT	115.36 (97.30)	121.58 (164.14)	0.02 (.00)	ns
CF	35.00 (18.47)	52.92 (18.49)	10.70 (.20)	.002
Mean width of stroke on paper				
DAP	0.66 (0.41)	0.46 (0.21)	4.41 (.09)	.041
SWT	1.82 (0.82)	2.83 (2.19)	4.29 (.09)	.044
CF	1.56 (2.55)	1.31 (0.58)	.21 (.01)	ns
Mean pressure on pen				
DAP	440.79 (159.61)	465.23 (188.86)	.22 (.01)	ns
SWT	419.05 (161.81)	579.12 (194.11)	9.14** (.17)	.004
CF	477.95 (195.69)	618.97 (180.80)	6.46* (.13)	.015

Note: DD = Group with drawing difficulties; NDD = Group with no drawing difficulties; DAP = Draw-a-Person test, SWT = Stars and Waves test, CF = Complex Figure test

* $p < 0.05$; ** $p < 0.01$

3.5. Correlations between process measures and drawing task scores among children with difficulties drawing

No significant correlations were found between the process measures and the DAP final task scores. However, a medium significant correlation was found between the task score and the width of the stroke on paper in the SWT ($r = .460$, $p = .021$), meaning the wider the stroke on paper, the higher the product score in the drawing task. Significant correlations were also found between the final product score and the mean pressure score on the pen ($r = .54$, $p = .008$), meaning the better the quality of the drawing, the more pressure was put on the pen while drawing.

3.6. Drawing characteristics that predict group classification

Discriminant analysis results showed that based on one function ($\Lambda = .446$; $p < .001$), 93% of all the children, 87% of the children with DD and 100% of the children with NDD were correctly classified. A Kappa value of .872 ($p < .001$) was calculated, demonstrating that group classification did not occur by chance. The variables found to have the highest predictive values were the SWT product score (.651), the DAP product score (.443), the CF number of drawing strokes (.438), the SWT width of stroke on paper (.432) and the SWT pressure on pen (.302), whose functions refer to both the product scores and the process measures. It seems the function differentiates between the two categories and classifies the children into a DD group that consists of children who receive low scores (-1.113) and children classified as NDD who receive high scores (1.067).

Because most variables of the function refer to the SWT, distinctive validity was evaluated for this task, including the SWT product and process measures. Results showed that based on one function ($\Lambda = .620$; $p = <.001$), 80% of all children, 76% of the DD group and 84% of the NDD group were correctly classified according to this function. A Kappa value of .600 ($p < .001$) was calculated, demonstrating that group classification did not occur by chance. The three variables that contributed

most to the prediction were the drawing product's SWT score (.912), pen stroke width on paper (.566) and mean pressure applied to the paper (.466). The function differentiates between the two categories. The children who receive a low score (-.768) are classified as with DD and children who receive a high score (.768) as with NDD.

4. DISCUSSION

The aim of this study was to analyze and compare differences in the drawing characteristics of children with and without drawing difficulties according to their teacher's' reports based on the DPSQ. The significant group differences found in both the drawing product and drawing process characteristics support the initial classification of the children according to the DPSQ. These results strengthen the validity of the DPSQ as completed by teachers and its sensitivity to differentiate between children with and without drawing difficulties [17]. Indeed, the comparison of DPSQ items indicates that each item contributed to the significance of group differentiation. The findings of deficient performance product characteristics of children with DD in all three drawing tasks conforms with previous studies focused on children with DCD and attention deficit hyperactivity disorder who are confronted with deficient grapho-motor abilities. Their drawing was characterized by more mistakes, fewer details and less organization compared to children with typical development [17,25,35]. This corresponds with the accepted principle of scoring drawing tasks according to the number of items in the drawing and the presumption that this represents the child's maturity and abilities [16,30,37].

The current study achieved further evidence to different performance mechanism by children with DD through the drawing process measures. Children with DD drew fewer pen strokes than the controls in two (DAP, CF) of the three drawing tasks. Furthermore, significant differences were found in the mean stroke width of the DAP and SWT tasks and in the pressure applied to the writing surface in the SWT and CF tasks. While in the DAP task, children with DD drew with a significantly higher stroke width; in the SWT, they drew with a significantly lower stroke width compared to the children with NDD. In both the SWT and CF tasks, they applied significantly less pressure on the writing surface.

Several reasons may explain these findings, which are inconsistent along the three tasks. Although literature about drawing process characteristics is lacking, the finding of the wider pen stroke in the person drawing task is in line with handwriting analyses that found the letter size among children with handwriting difficulties was significantly larger than that of children without difficulties [25,38]. Thus, the ability to draw smaller elements can indicate more mature sensorimotor development [38], more accurate performance without unnecessary movement of over- or undershooting and better control of the neuromotor tremor [25]. Conversely, the width of the stroke was smaller among the DD group in the SWT in comparison to the NDD group. A possible explanation for this contrary finding is that the SWT drawing spreads over the entire page, and wide segments can represent higher quality drawing (e.g., waves drawn with a curved line across the page obtain the highest score on the SWT); whereas the DAP task includes only a drawing of a person, and the width of the stroke can express the size of the body parts (such as long arms or a large head).

Further, for the significant group differences found in the stroke quantity, width and length, children with DD applied significantly less pen pressure toward the writing surface in both SWT and CF tasks. Similar to the current results, previous studies focused on handwriting-process characteristics found that children with DCD used less pressure on the pen compared to children with typical development [5,27]. Nevertheless, in the DAP task, the pressure on the pen in both groups was lower than the pressure in the other two tasks. A possible reason is that DAP is a developmental activity that children of this age are more familiar with compared to the other tasks. When learning to write or draw something new, the child uses more muscle tone and contracts the hand muscles [27]. Therefore, pressure on the pen is a strategy used while performing a mentally or physically demanding task. In addition, this finding could relate to the longer time the children with DD spent with their pen in-air between drawing strokes compared to that of children with NDD while person drawing. Possibly, because the DAP task was a demanding task for the children with DD, they applied more pressure on

the paper while drawing but had more opportunities to relieve that pressure while the pen was in-air. Thus, the average pressure on the pen was similar to the pressure in the NDD group. Chang and Yu's [27] results of no differences in the pressure outcomes between children with and without handwriting difficulties support this explanation. They stated that writing complex letters requires more segments, lifting the pen more times and more stops, which lowers the average pressure-level outcome.

The moderate significant correlations found in the CF task between the final product score and the mean pressure applied to the paper process score indicate the need to conduct further studies to understand the performance process that leads to certain product levels among children with DD. That in drawing they received a higher product score and used more pressure on the pen supports Van Gemmert and Van Galen's [39] findings that linked increased pressure on the pen to high mental and physical task demands. Wann and Nimmo-Smith [40] stated that increased pressure may be related to reducing the letter size, to the required attention level and to copying tasks. The CF task is indeed a complex task for children younger than school age. It is unfamiliar to them and requires reference to small details, in addition to accuracy. These demands may explain the increased pressure on the pen while performing this task. Thus, the children put more mental and physical effort into the task and applied more pressure.

The discriminative analysis showed that three measures of the SWT task (product score, stroke width and pen pressure), as well as the DAP product score and the CF number of strokes, were the best characteristics for predicting group membership (93.6%). Including only the three SWT measures yielded satisficed results of group discrimination (80% for the entire sample). The product score has the highest contribution as a discriminative factor, followed by the two process measures, width of stroke and average pressure on pen measure. These findings support the contribution of combining the final product score with the process scores of the SWT and the importance of this assessment tool that can help preschool teachers in screening and identifying DD. The sensitivity of this task can be due to the inclusion of various shapes, such as drawing separate shapes (stars) and free movement (waves) and spatial organization [32]. In fact, the drawings in the test reflect the basic shapes of handwriting, and therefore the test can help in early identification of deficits that may affect acquiring handwriting skills in school [41]. The relationship between drawing in preschool and handwriting in school has been well established in the literature [e.g., 18,21,42]. Additionally, the fact that kinematic analysis of process measures in children's drawings can provide information about their future handwriting skills has been emphasized [22]. Thus, the findings of the current study support that observing the process measures of the SWT, including the width of stroke on paper and mean pressure on pen in addition to the final product score, can provide important information about the child's drawing abilities and future writing skills.

5. LIMITATIONS

This study has a number of limitations. The small sample size and the fact that data were collected from one geographical area in a community with unique cultural characteristics may limit the generalization of the findings. Moreover, different ways to score the task products and future research use different scoring approaches, which can add to the knowledge obtained in this study.

6. CONCLUSIONS AND CLINICAL IMPLICATIONS

Results of this study emphasize the importance of observing drawing as a global and dynamic process that includes the final product and the drawing process. This approach can contribute to precise evaluation of drawing difficulties in applying effective screening and intervention programs. Moreover, the findings show that specifically the SWT, whose goal is early identification of deficits that may affect acquisition of handwriting in school, is sensitive to identifying children's drawing difficulties when implementing both process and product task measures.

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