

서론

가 가

9)10), 11), 12), 13) 가

D2 가 14-16)

3 10% 가 가

가 , 가 가 17), 18) 가 가

1) 가 19)

(motor skills disorder) (developmental coordination disorder) (de- 20) 21)가

(implicit knowledge) - - - 가 가 , 1

2) 가 6

3) 2

연구방법

가 4)

1. 연구 대상

2001 3 2001 8 DSM -

가 가

(macrogr- 2

aphia) 5), (microgr- 가

aphia) 6), 7)8), ()

()가 . , , .
) (28 (5) (space leaving) : 1988 1 19
 21 , 7) 31 (14 , : (1)
 17) . , 가 . (2) ,

2. 연구 도구

1) , , : (萬) 가
 3 가
 0.1cm(=1mm) 가
 0.5mm . -
 -

3. 통계처리

1) : , ,
 Student 's t - test
 Levene 's test for equality of
 () variances . 5% .
 2) : ,
 Chi - square method ,
 1988 1 19 5% .
 22) 3) : , ,
 , , Pe-
 arson
 2) Spearman
 0 가 5% . SPSS/WIN
 version 7.00 .
 가 (-) ,
 (+) .

연구 결과

3) (phonological errors) :
 ,
 (, ,) ,
 가 , ,) ,
 (; , ,
), (,)
 .
 , () , () ,
 , 가 (T +, H ,
 ㄱ ㄴ)
 4) (semantic errors) : 6.16 ±

1. 쓰기 장애 아동과 정상 아동의 글씨 크기, 글자 사이의 간
 격, 단어 사이의 간격 비교(Table 1, 2)
 1) 8.80 ±
 3.30mm, 7.06 ± 2.38mm
 가 (t=22.27, df=
 5144, p<0.05),
 2.30 ± 1.93mm, 1.74 ± 1.90mm ,
 (t=8.63, df=3464, p<0.05).

Table 1. Comparisons of the height of the letters, spacing between letters and spacing between words across grades

		Writing disorder	Normal children	t	df	Statistical significance*
Total	HT	8.84 ± 3.30	7.06 ± 2.38	22.27	5144	p < 0.05
	SL	2.30 ± 1.93	1.74 ± 1.90	8.37	3464	p < 0.05
	SW	6.16 ± 4.00	7.12 ± 4.20	- 4.24	1301	p < 0.05
Grade 1	HT	11.07 ± 3.51	8.31 ± 2.62	10.80	579	p < 0.05
	SL	3.00 ± 1.95	2.69 ± 2.23	1.56	439	NS
	SW	8.10 ± 5.27	5.05 ± 2.93	4.19	133	p < 0.05
Grade 2	HT	9.72 ± 2.65	7.90 ± 2.74	5.97	517	p < 0.05
	SL	2.26 ± 1.28	2.02 ± 1.53	1.20	364	NS
	SW	6.24 ± 3.11	7.28 ± 3.58	- 1.24	113	NS
Grade 3	HT	9.25 ± 3.41	7.42 ± 2.29	9.83	1123	p < 0.05
	SL	2.65 ± 1.94	1.90 ± 1.91	5.30	782	p < 0.05
	SW	6.53 ± 4.14	9.15 ± 6.95	- 4.06	294	p < 0.05
Grade 4	HT	9.22 ± 2.50	7.43 ± 2.15	12.14	996	p < 0.05
	SL	2.55 ± 2.03	1.84 ± 2.36	3.99	649	p < 0.05
	SW	6.88 ± 3.56	8.16 ± 3.03	- 3.00	236	p < 0.05
Grade 5	HT	7.23 ± 2.75	5.99 ± 1.62	8.23	990	p < 0.05
	SL	1.30 ± 1.53	0.78 ± 1.04	4.71	626	p < 0.05
	SW	4.91 ± 3.54	5.98 ± 2.76	- 2.60	258	p < 0.05
Grade 6	HT	8.39 ± 3.37	5.45 ± 1.38	16.58	929	p < 0.05
	SL	2.28 ± 1.92	1.19 ± 1.17	8.16	594	p < 0.05
	SW	5.60 ± 3.58	6.14 ± 2.36	- 1.39	257	NS

HT : mean heights of the letters

SW : mean spacings between the words

NS : not significant

SL : mean spacings between the letters

* : Based upon Student's t-test

4.00mm, 7.12 ± 4.20mm

(t = - 4.24, df = 1301, p < 0.05).

가 , (: 8.47 ± 3.21mm, : 7.15 ± 2.35mm ; t = 12.45, df = 2292. 29, p < 0.05) (: 5.65 ± 3.74mm, : 8.72 ± 5.17mm ; t = - 8.33, df = 359. 10, p < 0.05)

가

(t = 0.10, df = 1993, p > 0.05).

(: 10.19 ± 3.29mm, : 7.00 ± 2.39mm ; t = 21.20, df = 777.89, p < 0.05), (: 2.74 ± 1.81mm, : 1.54 ± 1.64mm ; t = 11.26, df = 589.55, p < 0.05) (: 8.39 ± 4.24mm, : 6.19 ± 3.09mm ; t = 5.52, df = 182.30, p < 0.05)

2) 학년 별 비교

(1) 1 :

(3.00 ± 1.95mm, 2.69 ± 2.23mm ; t = 1.56, df = 439, p > 0.05) (11.07 ± 3.51mm, 8.31 ± 2.62mm ; t = 10.80, df = 579, p < 0.05) (8.10 ± 5.27mm, 5.05 ± 2.93mm ; t = 4.19, df = 133, p < 0.05)

가

(2) 2 :

(9.72 ± 2.65mm) (7.90 ± 2.74mm) 가 (t = 5.97, df = 517, p < 0.05).

(3) 3 :

Table 2. Comparisons of the heights of letters, letter spacings, and word spacings across grades and sex

			WD	Control	t	df	Statistical significance*
Grade 1	Heights	M	9.31 ± 2.60	8.00 ± 2.17	3.44	109.76	p<0.05
		F	12.55 ± 3.49	8.38 ± 2.70	13.43	401	p<0.05
	Letter spacings	M	2.95 ± 2.18	5.19 ± 1.40	- 6.88	74.81	p<0.05
		F	3.05 ± 1.69	2.29 ± 2.08	3.41	251.96	p<0.05
	Word spacings	M	7.68 ± 6.01	7.70 ± 3.71	- 0.01	39	NS
		F	8.50 ± 4.57	4.62 ± 2.57	5.28	92	p<0.05
Grade 2	Heights	M	9.63 ± 2.31	8.16 ± 1.80	3.55	97	p<0.05
		F	9.80 ± 2.97	7.86 ± 2.85	4.49	418	p<0.05
	Letter spacings	M	1.83 ± 1.27	2.81 ± 1.40	- 2.97	64	p<0.05
		F	2.69 ± 1.16	1.93 ± 1.52	2.85	298	p<0.05
	Word spacings	M	8.27 ± 2.65	5.08 ± 1.73	3.45	21	p<0.05
		F	4.20 ± 2.04	7.67 ± 3.70	- 2.90	90	p<0.05
Grade 3	Heights	M	9.77 ± 3.62	7.29 ± 2.29	3.72	590	p<0.05
		F	8.17 ± 2.61	8.10 ± 2.13	0.20	293	NS
	Letter spacings	M	2.55 ± 1.95	1.94 ± 2.01	12.04	805.40	p<0.05
		F	2.89 ± 1.92	1.69 ± 1.36	4.80	124.55	p<0.05
	Word spacings	M	5.54 ± 3.62	10.47 ± 6.66	- 6.63	143.62	p<0.05
		F	8.67 ± 4.42	1.53 ± 1.18	6.56	72	p<0.05
Grade 4	Heights	M	9.22 ± 2.50	7.92 ± 2.63	6.21	660	p<0.05
		F	NA	7.10 ± 1.68	NA	NA	-
	Letter spacings	M	2.55 ± 2.03	2.35 ± 2.91	0.80	261.38	NS
		F	NA	1.46 ± 1.73	NA	NA	-
	Word spacings	M	6.99 ± 3.50	9.24 ± 3.27	- 3.84	158	p<0.05
		F	NA	7.55 ± 2.65	NA	NA	-
Grade 5	Heights	M	5.99 ± 1.65	5.05 ± 1.20	6.34	173.78	p<0.05
		F	11.04 ± 1.81	6.25 ± 1.62	26.94	235.27	p<0.05
	Letter spacings	M	1.02 ± 1.27	0.76 ± 1.07	1.67	102.41	NS
		F	2.18 ± 1.88	0.78 ± 1.04	7.96	277	p<0.05
	Word spacings	M	3.84 ± 2.65	7.82 ± 2.93	- 6.60	37.69	p<0.05
		F	9.09 ± 3.40	5.32 ± 2.39	6.58	107	p<0.05
Grade 6	Heights	M	8.39 ± 3.37	6.16 ± 1.40	7.19	642	p<0.05
		F	NA	5.16 ± 1.26	NA	NA	-
	Letter spacings	M	2.28 ± 1.92	1.53 ± 0.99	3.42	407	p<0.05
		F	NA	1.04 ± 1.22	NA	NA	-
	Word spacings	M	5.62 ± 3.57	5.93 ± 2.77	- 0.59	88.56	NS
		F	NA	6.33 ± 2.06	NA	NA	-

M : male F : female MD : writing disorder * : Based upon ²-test(p<0.05)

(9.25 ± 23.41mm, 7.42 ± 2.29mm ; t= - 4.06, df=294, p<0.05)
 t=9.83, p<0.05), (2.65 ± 1.94mm, , 가
 1.90 ± 1.91mm ; t=5.30, df=782, p<0.05) ,
 (6.53 ± 4.14mm, 9.15 ± 6.95mm ; .

(4) 4 : 4 , 998.51, $p < 0.05$), (8.72 ± 6.19mm) (6.19 ± 3.09mm) . (- 0.12 ± 1.62 °)

(9.22 ± 2.50mm), (2.55 ± 2.03mm) (1.37 ± 4.79 °) (t= (7.43 ± 2.15mm, 1.84 ± 2.36mm) - 11.48, df=2223.32, $p < 0.05$). (t=12.14, df=996, $p < 0.05$; t= 3.99, df=649, $p < 0.05$), (1) 1 : (9.31 ± 2.60mm) (6.88 ± 3.56mm) (8.16 ± 3.03mm) (12.55 ± 3.49mm) 가 (t= - 3.00, df=236, $p < 0.05$). (t=3.44, df=109.76, $p < 0.05$), (: 2.95 ± 2.18mm, : 5.19 ± 1.40mm ; t= - 6.88, df=74.81, $p < 0.05$)

(5) 5 : (7.23 ± 2.75mm, 5.99 ± 1.62mm ; t=8.23, df=990, $p < 0.05$) (1.30 ± 1.53mm, 0.78 ± 1.04mm ; t=4.71, df=626, $p < 0.05$) (4.91 ± 3.54mm, 5.98 ± 2.76mm ; t= - 2.60, df=258, $p < 0.05$) 가 가 (: 7.68 ± 6.01mm, : 7.70 ± 3.71mm ; t= - 0.01, df=39, $p > 0.05$) 가 가 12.55 ± 3.49mm, 8.38 ± 2.70mm 가 (t=13.43, df=401, $p < 0.05$), (3.05 ± 1.69mm) (2.29 ± 2.08mm) 가 (Fig. 1). (8.50 ± 4.57mm) (4.62 ± 2.57mm) (t=5.28, df=39, $p < 0.05$).

3) 성별에 따른 비교(Fig. 1 - 4) 가 (8.47 ± 3.21mm) (10.19 ± 3.29mm) (t= - 11.22, df=2601, $p < 0.05$), (2.18 ± 1.95mm) (2.74 ± 1.81mm) (t= - 4.98, df=1744, $p < 0.05$). (5.65 ± 3.74mm) (8.39 ± 4.24mm) (t= - 6.83, df=185.94, $p < 0.05$). 1.29 ± 3.48 °, 2.50 ± 5.09 ° , (t= - 5.30, df=715.78, $p < 0.05$). (: 7.15 ± 2.35mm, : 7.00 ± 2.39mm ; t=1.55, df=2541, $p > 0.05$) , (2.08 ± 2.25mm) (1.54 ± 1.64mm) (t=5.25, df= (9.63 ± 2.31mm)가 (8.16 ± 1.80mm) (t=3.55, df=97, $p < 0.05$), (1.83 ± 1.27mm) (2.81 ± 1.40mm) . (8.27 ± 2.65mm) (5.08 ± 1.73mm) (t=3.45, df= 21, $p < 0.05$). (9.80 ± 2.97mm) (7.86 ± 2.85mm) (t=4.49, df=418, $p < 0.05$), (2.69 ± 1.16mm) (1.93 ± 1.52mm) (t=2.85, df=298, $p < 0.05$). (4.20 ± 2.04mm) (7.67 ± 3.70mm) (t= - 2.90, df=90, $p < 0.05$),

가 가 10.20% ,
 1.42%

(3) 3 : 가 12.31%
 (9.77 ± 3.62mm) (7.29 ± 2.29mm)
 (t=3.72, df=590, p<0.05),
 (2.55 ± 1.95mm)
 (1.94 ± 2.01mm) (t=12.04,
 df=805.40, p<0.05).

가 (5.54 ± 3.62mm)

(10.47 ± 6.66mm)
 (t = - 6.63, df= 143.62, p<0.05).
 가

가

(4) 4 :

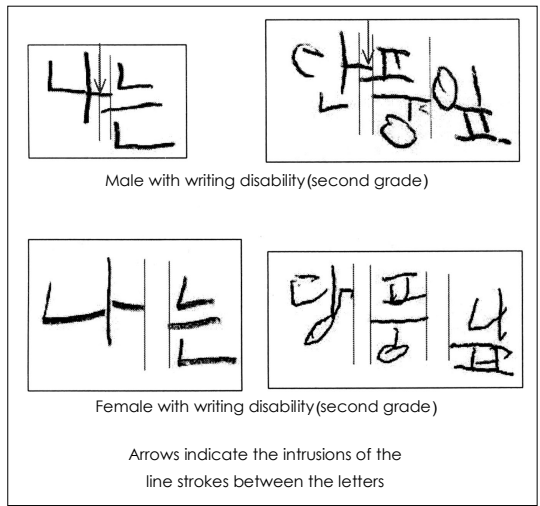


Fig. 1. Comparative photographs about the intrusion of line strokes between letters in male and female.

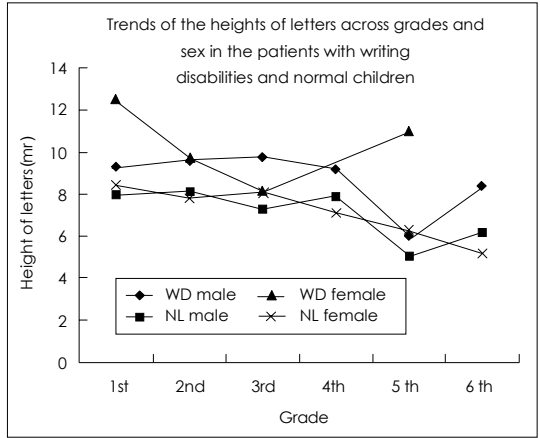


Fig. 2. The distribution of the heights of letters across grades and sex in the patients with writing disabilities and normal children. WD : writing disability, NL : normal control.

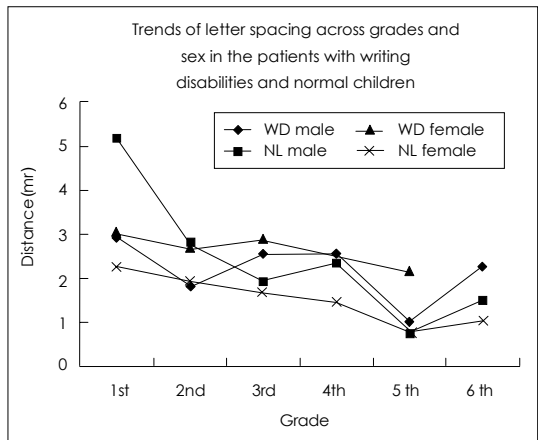


Fig. 3. The distribution of letter spacings across grades and sex in the patients with writing disabilities and normal children. WD : writing disability, NL : normal control.

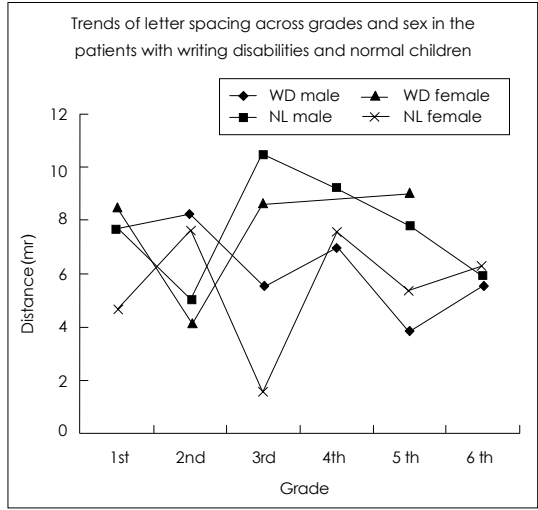


Fig. 4. The distribution of the word spacings across grades and sex in the patients with writing disabilities and normal children. WD : writing disability, NL : normal control.

(t=26.94, df=235.27, p<0.05),
 (9.22 ± 2.50mm)가 (2.18 ± 1.88mm)
 (7.92 ± 2.63mm) (0.78 ± 1.04mm) (t=7.96,
 (t=6.21, df=660, p<0.05), df=7.96, p<0.05).
 (6.99 ± 3.50mm) (9.24 ± (5.32 ± 2.39mm) (9.09 ± 3.40mm)
 3.27mm) (t= - 3.84, df=158, p<0.05). df=107, p<0.05). (t=6.58,
 가 6.75% 1.27% 가 (3.16%) (2.25%)
 가
 (5) 5 : (6) 6 : 가
 (5.99 ± 1.65mm) (5.05 ± 가 가
 1.20mm) (t=6.34, df=173.78, (8.39 ± 3.37mm)가 (6.16 ± 1.40mm)
 p<0.05), (1.02 ± 가 가
 1.27mm) (0.76 ± 1.07mm) (t=7.19, df=642, p<0.05),
 (t=1.67, df=102.41, p<0.05). (2.28 ± 1.92mm)
 (3.84 ± 2.65mm) (1.53 ± 0.99mm) (t=3.42, df=407,
 (7.82 ± 2.93mm) (t= - 6.60, df=37.69, p<0.05). (5.62 ± 3.57mm) (5.93 ± 2.77mm)
 p<0.05). 5 (t= - 0.59, df=88.56,
 가 가 (5.47%) (6.55%)
 (0.61%) p>0.05).
 (2.34%)
 (11.04 ± 1.81mm) (6.25 ± 1.62mm) 5

Table 3. Correlations among letter heights, letter spacings, word spacings and angles across grades in the patients with writing disabilities and normal children

Male patients with WD						Male controls					
	GR	HT	LS	WS	ANG		GR	HT	LS	WS	ANG
GR	1.00 ^a					GR	1.00				
HT	-0.23*	1.00				HT	-0.26*	1.00			
LS	-0.16*	0.15*	1.00			LS	-0.27*	0.11*	1.00		
WS	-0.11*	0.17*	0.99*	1.00		WS	-0.19*	0.29*	0.99*	1.00	
ANG	-0.16*	0.05*	-0.07*	-0.01	1.00	ANG	0.07*	-0.00	-0.12*	-0.11	1.00

Female patients with WD						Female controls					
	GR	HT	LS	WS	ANG		GR	HT	LS	WS	ANG
GR	1.00					GR	1.00				
HT	-0.16*	1.00				HT	-0.45*	1.00			
LS	-0.19*	0.07	1.00			LS	-0.31*	0.14*	1.00		
WS	0.15	0.04	-	1.00		WS	0.04	0.99*	0.99*	1.00	
ANG	0.31*	0.23*	-0.10	0.06	1.00	ANG	-0.15*	0.02	0.02	-0.02	1.00

WD : Writing disability

HT : letter heights

WS : word spacing

a : Values are Pearson's correlation coefficients(p<0.05)

GR : grade

LS : letter spacing

ANG : angles between the horizon and letter strings

4) 연령에 따른 변화(Table 3) (r= -0.18, p<0.05). 가
 (1) : 가 (r= -0.17, p<0.05),
 (r= -0.16, (r= -0.17, p<0.05),
 p<0.05), (r= -0.23, p<0.05), (r=0.10, p>0.05).
 (r= -0.16, p<0.05) 가 (r=0.35, p<0.05)
 (2) :

Table 4. Correlation analyses among letter heights, letter spacings and word spacings across age and groups

	Male								Female							
	WD				Control				WD				Control			
	HT	LS	WS	ANG	HT	LS	WS	ANG	HT	LS	WS	ANG	HT	LS	WS	ANG
Grade 1																
HT	1.00				1.00				1.00				1.00			
LS	0.16	1.00			-0.05	1.00			0.10	1.00			0.14	1.00		
WS	-0.20	0.99*	1.00		0.21	-	1.00		-0.10	-	1.00		-0.04	0.99*	1.00	
ANG	0.08	-0.14	-*	1.00	-	-	-	1.00	0.06	-0.04	0.18	1.00	0.06	-0.22*	0.31*	1.00
Grade 2																
HT	1.00				1.00				1.00				1.00			
LS	0.18	1.00			0.00	1.00			0.15	1.00			-0.18*	1.00		
WS	0.30	-	1.00		0.59*	-	1.00		0.10	-	1.00		0.33*	-	1.00	
ANG	-0.30*	-0.22	-0.26	1.00	-0.08	-0.33	-0.42	1.00	0.16	0.20	0.06	1.00	0.09	0.07	0.29*	1.00
Grade 3																
HT	1.00				1.00				1.00				1.00			
LS	-0.06	1.00			-0.10	1.00			0.15	1.00			0.03	1.00		
WS	0.13	-	1.00		0.37*	-	1.00		0.12	-	1.00		0.16	0.99*	1.00	
ANG	-0.07	-0.02	0.10	1.00	0.11*	-0.23*	-0.05	1.00	0.06	0.04	-0.04	1.00	0.15	0.10	0.01	1.00
Grade 4																
HT	1.00				1.00				1.00				1.00			
LS	-0.16*	1.00			0.11	1.00			NA	1.00			0.13	1.00		
WS	-0.13	-	1.00		0.22	0.99*	1.00		NA	NA	1.00		-0.02	-	1.00	
ANG	0.18*	-0.16*	-0.19	1.00	-0.25*	-0.08	-0.11	1.00	NA	NA	NA	1.00	0.20*	0.14*	-0.20	1.00
Grade 5																
HT	1.00				1.00				1.00				1.00			
LS	-0.01	1.00			-0.09	1.00			-0.03	1.00			0.13	1.00		
WS	-0.21*	-	1.00		-0.08	-	1.00		0.12	-	1.00		0.05	-	1.00	
ANG	-0.19*	0.07	-0.01	1.00	-	-	-	1.00	0.11	-0.09	0.13	1.00	-0.07	-0.20*	0.20	1.00
Grade 6																
HT	1.00				1.00				1.00				1.00			
LS	0.06	1.00			-0.09	1.00			NA	1.00			-0.02	1.00		
WS	0.13	0.99*	1.00		-0.09	-	1.00		NA	NA	1.00		0.07	-	1.00	
ANG	0.09*	-0.08	0.06	1.00	-	-	-	1.00	NA	NA	NA	1.00	-0.20*	0.12	-0.36*	1.00

WD : writing disability HT : letter heights LS : letter spacing WS : word spacing
 ANG : angles between the line and horizon NA : not available
 - : correlation coefficients were not calculated because at least one variable was constant.
 * : Values are Pearson's correlation coefficients(p<0.05)

가 (r = - 0.26, p<0.05), (r=0.29, p<0.05).
(r = - 0.27, p<0.05) (r= - (3) 3 : 가
0.19, p<0.05) , (r=
가 ,
가 0.37, p<0.05),
(r=0.07, p<0.05). (r=0.11, p<0.05)
(r = - 0.45, p<0.05)
(r = - 0.31, p<0.05) (r = - 0.23, p<0.05)
, 가 가 . 가
(r=
0.03, p>0.05).
가 (r= (r=0.20, p<0.05)
- 0.15, p<0.05) ,
(r = - 0.20, p<0.05)
5) 연령과 성별에 따른 글씨의 크기, 글자 사이의 간격, 단
어 사이의 간격의 상호관계(Table 4)
(1) 1 : 가 (4) 4 : 4
(r= 가 가 ,
0.99, p<0.05), 가 가
(r = - 0.68, p<0.05) (r = - 0.16, p<0.05)
, 가 가 (r = - 0.16,
p<0.05) .
가 가 (r=0.99,
p<0.05) , (r = - 0.25,
(r=0.99, p<0.05), p<0.05)
(r = - 0.22, p<0.05), (r=0.20, p<0.05) ,
(r=0.31,
p<0.05) . (r=0.14, p<0.05)
(2) 2 : 가 (r=
- 0.30, p<0.05) (5) 5 : 가
, (r = - 0.21) ,
(r = - 0.19,
(r=0.59, p<0.05) p<0.05)
가 가
가 가
(r = - 0.18, p<0.05) (r = - 0.20, p<0.05)

(6) 6 :
 가 (r=0.09, p<0.05),
 가 (r=0.99, p<0.05)

Table 5. Nonparametric analysis between the patients with writing disorder and normal children across grade and gender

Grade		Gender	WD	Control	²	Statistical significance
Grade 1	PE	M	9.46% (14/148)	6.00% (3/50)	0.57	NS
		F	13.33% (28/210)	2.62% (11/420)	27.68	p<0.05
	SE	M	0% (0/148)	0% (0/50)	-	NS
		F	9.52% (20/210)	0.48% (2/420)	31.92	p<0.05
	SpL	M	11.49% (17/148)	2.00% (1/50)	370	NS
		F	6.67% (14/210)	7.38% (31/420)	0.05	NS
Grade 2	PE	M	1.04% (1/96)	6.00% (3/50)	3.03	NS
		F	0% (0/98)	0.81% (4/492)	0.04	NS
	SE	M	0% (0/96)	0% (0/50)	-	NS
		F	1.04% (1/98)	0.20% (1/492)	0.20	NS
	SpL	M	0% (0/96)	2.00% (1/50)	1.93	NS
		F	10.20% (10/98)	1.42% (7/492)	22.52	p<0.05
Grade 3	PE	M	5.66% (40/707)	2.69% (12/446)	5.59	p<0.05
		F	3.41% (9/264)	0% (0/178)	2.03	NS
	SE	M	0.99% (7/707)	0.67% (3/446)	0.32	NS
		F	1.14% (3/264)	0% (0/178)	27.88	p<0.05
	SpL	M	12.31% (87/707)	1.79% (8/446)	39.97	p<0.05
		F	14.39% (87/707)	1.12% (2/178)	22.60	p<0.05
Grade 4	PE	M	3.68% (24/652)	1.48% (7/472)	4.93	p<0.05
		F	NA	1.48% (7/474)	-	-
	SE	M	0.15% (1/652)	0.21% (1/472)	0.05	NS
		F	NA	0.21% (1/474)	-	-
	SpL	M	6.75% (44/652)	1.27% (6/472)	19.33	p<0.05
		F	NA	1.48% (7/474)	-	-
Grade 5	PE	M	1.56% (8/512)	0.41% (2/490)	3.38	NS
		F	1.58% (5/316)	0.28% (1/356)	0.89	NS
	SE	M	0.20% (1/512)	0.20% (1/490)	0.00	NS
		F	0% (0/316)	0.84% (3/356)	4.76	p<0.05
	SpL	M	5.47% (28/512)	0.61% (3/490)	19.70	p<0.05
		F	3.16% (10/316)	2.25% (8/356)	0.54	NS
Grade 6	PE	M	6.01% (56/932)	0.98% (5/512)	20.68	p<0.05
		F	NA	0.74% (3/406)	-	-
	SE	M	1.39% (13/932)	0.54% (5/932)	4.95	p<0.05
		F	NA	0% (0/406)	-	-
	SpL	M	6.55% (61/932)	2.34% (12/512)	12.15	p<0.05
		F	NA	0% (0/406)	-	-

WD : writing disability
 SpL : space leaving

PE : phonological error
 M : male

SE: semantic error
 F : female

NS : not significant
 NA : not available

가 .
($r = -0.20, p < 0.05$)가 ,

($r = -0.36, p < 0.05$)가 .

2. 음운적 오류, 의미적 오류, 띄어쓰기 오류 분석

가
(,)
(19.73%)
,

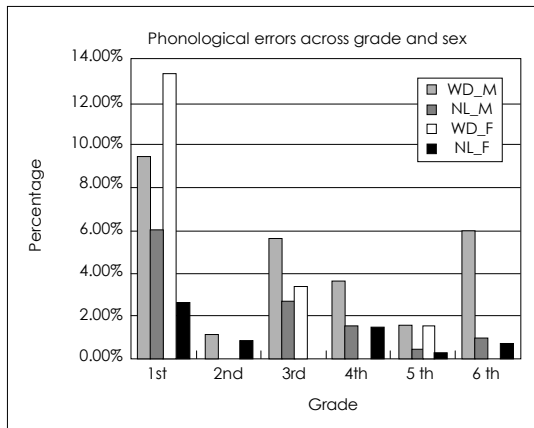


Fig. 5. Phonological errors across grade and sex in the patients with writing disabilities and normal children. WD : writing disability, NL : normal control, M : male, F : female.

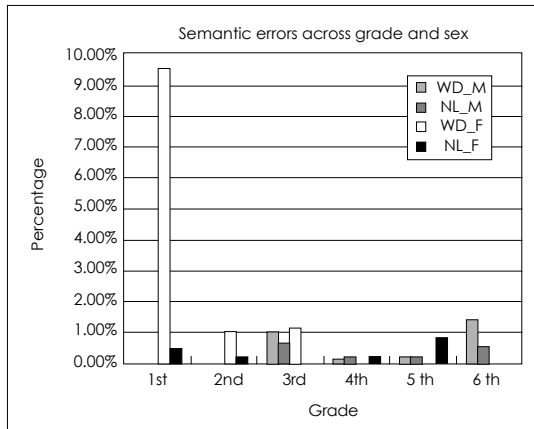


Fig. 6. Semantic errors across grade and sex in the patients with writing disabilities and normal children. WD : writing disability, NL : normal control, M : male, F : female.

1) 연령과 성별에 따른 음운적 이상, 의미적 이상, 띄어쓰기 오류의 빈도 비교 (Table 5, Fig. 5 - 7)

(1) 1 : 가
($\chi^2 = 0.57, df = 1, p > 0.05$)
, ($\chi^2 = 27.68, df = 1, p < 0.05$)
($\chi^2 = 31.92, df = 1, p < 0.05$). 가

(2) 2 : 가
($\chi^2 = 3.03, df = 1, p > 0.05$), ($\chi^2 = 0.04, df = 1, p > 0.05$)

,
($\chi^2 = 0.20, df = 1, p > 0.05$).
($\chi^2 = 1.93, df = 1, p > 0.05$)
, ($\chi^2 = 22.52, df = 1, p < 0.05$)

(3) 3 : ($\chi^2 = 5.59, df = 1, p < 0.05$)
($\chi^2 = 2.03, df = 1, p < 0.05$)

($\chi^2 = 0.32, df = 1, p < 0.05$)
, ($\chi^2 = 27.88, df = 1, p < 0.05$)

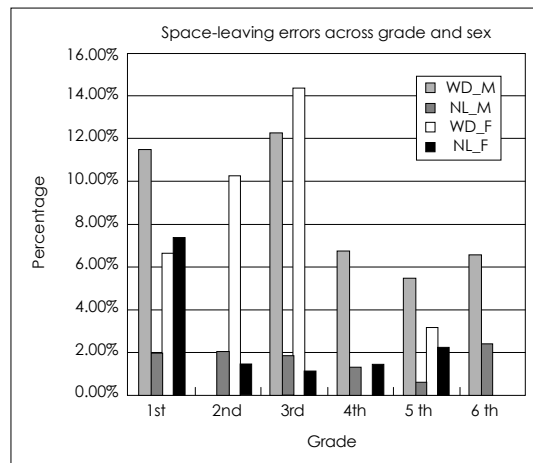


Fig. 7. Space-leaving errors across grade and sex in the patients with writing disabilities and normal children. WD : writing disability, NL : normal control, M : male, F : female.

$(\chi^2=27.88, df=1, p<0.05)$ (1.27%) ($\chi^2=$
 $(\chi^2=22.60, df=1, p<0.05)$ 19.33, $df=1, p<0.05$).
 (: 12.31%, : 14.39%) (: (5) 5 : ($\chi^2=$
 1.79%, : 1.12%) 가 . 3.38, $df=1, p>0.05$) ($\chi^2=0.89, df=1, p>$
 (4) 4 : 4 0.05)
 ($\chi^2=3.38, df=1, p>0.05$)
 ($\chi^2=4.76, df=1,$
 $p<0.05$)
 (3.68%) (1.48%) ($\chi^2=19.70, df=1, p<0.05$)
 ($\chi^2=4.93, df=1, p<0.05$) ($\chi^2=0.54, df=1, p>0.05$)
 ($\chi^2=0.05,$
 $df=1, p>0.05$). (6) 6 : 4 가
 가 (6.75%)

Table 6. Correlation analyses among phonological errors, semantic errors and space-leaving errors across grades and sex in the patients with writing disabilities and normal children

	Male						Female					
	WD			Control			WD			Control		
Grade 1												
PE	1.00			1.00			1.00			1.00		
SE	-	-		-	1.00		0.80*	1.00		0.42*	1.00	
SpL	0.93*	-	1.00	0.57*	-	1.00	0.68*	0.85*	1.00	0.59*	0.25*	1.00
Grade 2												
PE	1.00			1.00			1.00			1.00		
SE	-	1.00		-	1.00		-	1.00		0.50*	1.00	
SpL	-	-	1.00	0.57*	-	1.00	0.30*	-	1.00	0.75*	0.38*	1.00
Grade 3												
PE	1.00			1.00			1.00			1.00		
SE	0.41*	1.00		0.50*	1.00		0.26*	1.00		-	1.00	
SpL	0.65*	0.27*	1.00	0.81*	0.61*	1.00	0.26*	0.99*	1.00	-	-	1.00
Grade 4												
PE	1.00			1.00			1.00			1.00		
SE	0.20*	1.00		0.38*	1.00		NA	1.00		0.38*	1.00	
SpL	0.73*	0.15*	1.00	0.93*	0.41*	1.00	NA	NA	1.00	0.99*	0.38*	1.00
Grade 5												
PE	1.00			1.00			1.00			1.00		
SE	0.35*	1.00		0.71*	1.00		-	1.00		0.58*	1.00	
SpL	0.52*	0.18*	1.00	0.82*	0.58*	1.00	-	0.99*	1.00	0.35*	0.61*	1.00
Grade 6												
PE	1.00			1.00			1.00			1.00		
SE	0.35*	1.00		0.71*	1.00		NA	1.00		-	1.00	
SpL	0.52*	0.18*	1.00	0.82*	0.58*	1.00	NA	NA	1.00	-	-	1.00

WD : writing disability PE : phonological errors SE : semantic errors SpL : space-leaving errors
 * : Values are significant based upon Spearman's correlation analyses($p<0.05$)

(6.01%), (1.39%), (6.55%)
 (0.98%, 0.54%, 2.34%
) 가 ($\chi^2=20.68, df=1,$
 $p<0.05$; $\chi^2=4.95, df=1, p<0.05$; $\chi^2=12.15, df=1,$
 $p<0.05$).

2) 연령과 성별에 따른 음운적 오류, 의미적 오류 그리고 띄어쓰기 오류의 상호관계(Table 6)

(1) : , 가
 ($\chi^2=28.17, df=5, p<0.05$),
 ($r = -0.01, p>0.05$).
 ($\chi^2=13.29, df=5,$
 $p<0.05$),
 ($r =0.03, p>0.05$).
 ($\chi^2=37.08, df=5,$
 $p<0.05$), ($r = -0.06,$
 $p<0.05$).
 가
 ($\chi^2=28.17, df=5,$
 $p<0.05$) ($r = -0.08, p<0.05$)
 , 가
 ($\chi^2=2.86, df=5, p>0.05$).
 ($\chi^2=5.54,$
 $df=5, p>0.05$).

Table 6

(2) : , 가
 ($\chi^2=75.55, df=5, p<0.05$),
 ($r = -0.24, p<0.05$).
 가 ($\chi^2=$
 $35.12, df=5, p<0.05$), 가
 ($r = -0.07, p<0.05$).
 ($\chi^2=25.53, df=5,$
 $p<0.05$), Spearman $-0.07, p=0.051$

Kendall's tau - b $-0.06, p<0.05$
 가 . 가
 ($\chi^2=14.31, df=5, p<0.05$; $r = -0.05,$
 $p<0.05$).
 ($\chi^2=5.95, df=5, p>0.05$).
 ($\chi^2=$
 $57.04, df=5, p<0.05$) 가
 ($r = -0.12, p<0.05$).

고찰

가
 가
 , 가
 ($r = -0.16$)
 가
 1, 2
 3, 4, 5 , 6
 1
 가

가
 가
 가
 ($r=0.11 \sim 0.15$)
 ($r=0.99$).
 ()

(ㄱ, ㄴ, ㄹ, ㄷ, ㄱ, ㄷ, ㄹ, ㄷ, ㄹ, ㄷ, ㄹ, ㄷ, ㄹ)

가 가 , 가 가 ,

가(音價)가 . 가 2 가 27)28)

가 가 , 가 29)

가 가 가

가 1, 2

가 2, 3

가 가

가 6 3 가

(8.39 ± 3.37mm)가 1

(8.00 ± 2.17mm) .

2 4 48 ((intrusion)

24 , 24) . Fig. 1

(Power 가

Spectral Density Analysis) ,

가 가 - (motion overflow)

(noise) 가 (pri-

23) 가 primary writing tremor)³⁰⁾ (writer's cr-

가 가 amp)³¹⁾ . Taylor

가 (motor skills 가

disorder) 가 .

가 가 가

가 24) , 가

가 - 32)

(visuo - motor integration),

(aiming), (tracing)

25) . Smits - Engelsman (2001) 26) (spatial

가 dysgraphia) ' , , , ,

(motor unit)가

(neuromotor noise)

33)

(Rolandic fissure) 가 가

(, , ,) 가 가 가 2

가 가 가 가 42)43)

34) 가 가 가 가 44)

(6.67%) (11.49%)

가 가 45)46)

가 가 가 가 가 가

가 1, 2 8mm 5,

6 5 6mm 가 9mm

가 가 4 가 가

()가 가 가 47)

가 -0.26 가 -0.45

가 가 가 가 48)

(motor coordination)

(morpheme)

가 가 가 가 가

가 가 가 3 4 가

35) 가 가 Martlew(1992)⁴⁹⁾

가 -0.11 -0.19 , 2

-0.27 -0.31 가 가

3 4 가 가

가 6 , 8 9 (morpheme)

36)37) (phonemic awareness) , 가

6 (drawing) ' 가

(writing) ' 38) 가

(grip) 3 48% 가

90% 가

39)40) 가 가 가 가

8 9 41) 가 가 가

가 가 가 가

(ㄱ, ㄴ, ㄷ, ㄹ, ㅁ, ㅂ, ㅃ, ㅅ, ㅆ, ㅈ, ㅊ, ㅋ, ㆁ)

() ,) ,

()

가

50)51)

가

52)53)

(multisensory method)⁵⁴⁾

55)

(line quality)

56-59)

60)61)가

가

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**COMPARATIVE STUDY UPON THE CHARACTERISTICS OF
WRITING BETWEEN THE PATIENTS WITH
WRITING DISABILITIES AND
NORMAL ELEMENTARY SCHOOL STUDENTS**

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Characteristics of handwriting were investigated and compared between the patients with writing disabilities and normal elementary school pupils. Generally, the heights of the letters of the patients were significantly larger than those of normal children, and letters of the patients were more sparsely distributed than those of controls. The distance between the words were significantly reduced in the patients' writings, which indicated that patients had much more problems of space-leaving than normal pupils. Letter heights differences were significant across all grades in the patients and normal controls. The heights of the letters decreased as they grew older, and the slope of the decrements were more steeper in normal girls ($r = -0.45$) than girls with writing disabilities ($r = -0.16$). Sex differences were found in the letter spacings in low grades (grades 1, 2), that is, the distances between the letters were significantly narrower in the male patients than normal boys in these grades, and the differences were almost indiscriminating in grades 3 through 5, and finally, in sixth grade, letter spacings were significantly broader in normal boys than male dysgraphics. In girls, letter spacings were significantly broader in the patients across all grades. These findings supports the hypothesis that male and female writings were qualitatively different and that distinct mechanisms served in boys and girls dysgraphics. Across all grades and sexes, spaces between the words of the patients were significantly broader than normal pupils, which suggested that space-leaving between the words was important in Korean writings. There was trend that letter spacings and word spacings decreased across grades, but in girls, no correlations between the letter spacings and grades were found. Correlation analyses revealed that letter heights and letter spacings had mild correlation ($r = 0.11 - 0.15$), and that letter spacings and word spacings had robust correlation ($r = 0.99$).

Phonological errors were mostly found in last phoneme (Jong-seong), especially double-phoneme (ㄴ, ㄴ, ㄴ, ㄴ, ㄴ, ㄴ, ㄴ, ㄴ, ㄴ, ㄴ), and in the case the sound values changed due to assimilations of phonemes. Semantic errors were rare in both groups. Space-leaving errors were correlated with phonological errors, and more frequent in boys than girls. In conclusion, significant differences existed in the letter heights, letter spacings, word spacings, and frequencies of phonological errors and space-leaving errors between the patients with writing disabilities and normal pupils. The characteristics of writings changed across grades and the developmental profiles were somewhat quantitatively different between the groups. The differences became obvious from the second-third grades.

KEY WORDS : Learning disability · Writing disability.