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Domain Thoughts in Gifted Students and Gifted Students with Learning Disabilities

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As an empirical test of a model of giftedness with learning disabilities (Song & Porath, 2011), this paper investigated domain thoughts of gifted students without learning disabilities and gifted students with learning disabilities (GLD) in reading, writing, and math. Gifted students in each group were interviewed and the data were analyzed for domain thoughts. The results showed that the former group of gifted students exhibited domain thoughts in a more balanced manner, whereas GLD students showed large discrepancies between domain thoughts; they showed weak specific domain thoughts in contrast to strong other domain thoughts. They also showed ambivalent attitudes even in a domain activity; they presented positive and negative thoughts at the same time. With a comprehensive explanation of the differences between the two groups of gifted students through a cognitive mechanism presented in the model of GLD model, this paper provides new approaches for identification and education of gifted students and GLD students.

Key Words: Intelligence, Domains, Giftedness, Learning disabilities, Gifted learning disabilities, Twice exceptionality

I. Introduction

In learning at school, gifted students may be divided into two groups: One isgifted students without learning disabilities, and the other group is gifted students with learning disabilities (GLD), or students who are twice exceptional. The former group shows their high academic achievement at school, whereas the latter generally suffers from learning in certain academic areas (Brody & Mills, 1997; Lovett & Lewandowski, 2014 McCoach et al., 2001; Silverman,

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2003). They, rather, exhibit superior learning outcomes in areas 'outside of class' (Baum, Owen, &Dixon, 1991; Munro, 2002; Snelling, 2007). Given that giftedness is defined by a high level of intelligence, it is paradoxical that GLD students, whose intelligence falls within the level of giftedness, do not learn well at school, compared to their gifted peers. Why and how does the paradoxical phenomenon happen?

Basically the answer to the question may be found in intelligence theories since giftedness is defined with reference to "intelligence." General intelligence researchers, who argue that intelligence is unitary and general (i.e., g) (e.g., Carroll, 1993; Jensen, 2002; Spearman, 1923) and that g is present in all domain-specific knowledge or performance, do not provide the proper answer because they hardly account for GLD. Considering few deny the existence of domain-specific abilities (Demetriou, 2002), GLD seems to be well understood by the perspective of multiple intelligences because it allows for uneven cognitive profile; one can show high ability in one area but disability in other area (Gardner, 1983; Renzulli, 1978; Sternberg, 1988). However, it is not known how multiple intelligences are interrelated. And thus, it is not known whether they are independent or not. Some researchers argue that Gardner's intelligences cannot be independent (Morgan, 1996; Klein, 1997). As such, the debates about the nature of intelligence and thus of giftedness traditionally have revolved around the characterization of intelligence as general or specific.

The integrated model of human abilities (Song & Porath, 2005) presents a cognitive mechanism that has the potential to explain the shortcomings of both g and multiple intelligences theories. The model hypothesizes how general and domain-specific aspects of human abilities may occur based on the interrelationships between cognitive components (e.g., abilities, attention, memory, mental space) suggested by major models or theories of intelligence - Three-Stratum Theory (Carroll, 1993), the united model of the mind (Case, Demetriou, Platsidou, & Kazi, 2001), the developmental theory (Case, 1992), Triarchic Theory (Sternberg, 1988), and Multiple Intelligence Theory (Gardner, 1983). Based on the interrelationships, the model explains the role of g in ability, what domain-specific abilities are, and how g is related to domain-specific abilities in the cognitive mechanism. According to the model, g, the ability to find relationships between domain stimuli and form domain knowledge, appears as domain-specific intelligences [i.e., multiple intelligences as defined by Gardner (1983)] when it engages with domain stimuli, which determine domains and are only domain-specific. In other words, domain-specific abilities or intelligences reflect general intelligence or g that appears in domains when g engages with domain stimuli coming through the sensory organs from the social and natural environments.

On the basis of the cognitive mechanism presented in the integrated model, the GLD model explained how uneven cognitive profiles can exist within an individual (Song & Porath, 2011).

According to the model, the function of g is limited by the size of mental space in the brain where memory and processing occur. An individual who has a small auditory or visual mental space may have weak auditory or visual memory and processing, exhibiting poor specific domain performances. That is, mental space limits the function of g through memory and processing, and thus even gifted students, who have high g, can be disabled in specific domains where domain memory and processing is weak. This is the case with GLD. For example, GLD students who have small auditory mental space may show poor performance in domains that require high auditory memory and processing (e.g., language-related domains). GLD students may exhibit large discrepancies between specific domain performances and their potential g. In this model, gifted students without LD refer to those who have large auditory and visual mental spaces in a relatively balanced manner, which enables them to have high auditory and visual domain functions and show high abilities in every domain in an independent or integrated manner (i.e., all-rounded).

The notion that one can be gifted in domains other than language or math is especially salient for gifted students with learning disabilities. Gifted students with learning disabilities (GLD) exhibit difficulties in auditory- sequential functioning (Bireley, Languis, & Williamson, 1992) that is required in reading, language arts, and many other academic subjects (Bender, 2001). These students show poor performance in reading, spelling, rote memorization and/or computation (or numeracy) (Munro, 2002; Silverman, 1989a; 1989b; 1993).

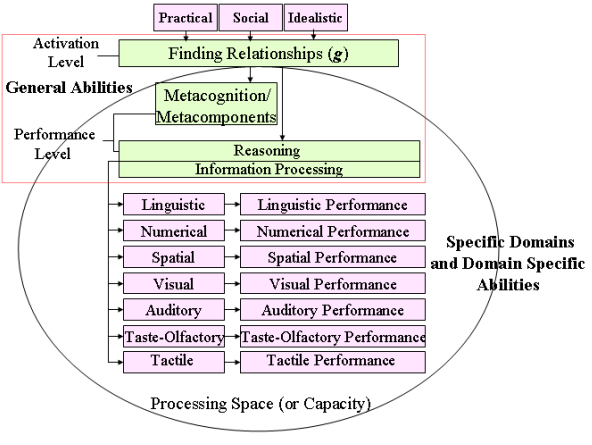
Despite these difficulties, GLD students may display high spatial (or wholistic) abilities (Munro, 2002; Silverman, 1989a; 1989b). They are superior in geometry, science, computer programming and graphics as well as art, music, poetry, and electronics. They are extraordinarily capable with puzzles and mazes and excellent at mathematical reasoning. They have a keen visual memory, unusual imagination, high creativity, and penetrating insights. They also easily grasp metaphors, analogies, and satire. GLD students are more likely to use global wholistic rather than analytic sequential learning strategies and learn in an all-or-nothing fashion rather than in a stepwise incremental way (Munro, 2002). This sub-group of GLD students may show high performance in visual domains and domains in which high visual functions are required but they show poor performance in auditory domains and domains in which high auditory functions are required.

The purpose of this study is to test the GLD model empirically. This study investigated how gifted students without LD and GLD students show domain thoughts in different ways in academic activities such as reading, writing, and math. Seeing that GLD students show high abilities in limited domains unlike gifted students, they may show differences in auditory and visual thoughts in such academic activities. The results of this study inform how gifted students can be learning-disabled and what the fundamental differences are between gifted

students and GLD students, accordingly suggesting a new perspective for identification and education of GLD students.

II. The Model of GLD

According to the integrated model of human abilities (Figure 1), humans, who are curious about knowledge by nature, sense stimuli and find relationships between stimuli and connect them through the found relationships. The connected stimuli are knowledge. That is, knowledge consists of two components, relationships and stimuli. The ability to find relationships and form knowledge is defined as general intelligence (g). To find relationships, an individual plans and controls his/her thinking processes (executive ability, i.e., metacognition, or metacomponents) (Demetriou, 2002; Sternberg, 1988) on one hand, and processes information (processing ability) (Sternberg, 1988) on the other hand. Since an individual finds relationships through those functions, executive and processing abilities are instrumental to g. Executive and processing abilities including g, fundamentally involved with knowledge formation, are defined as general abilities. When internally or externally stimulated, an individual at the activation level may activate the instrumental cognitive functions -- executive and processing functions at the performance level -- to find relationships. Ability at the general activation level is labeled g; and the other general abilities as those at the general performance level (Figure 1). Processing capacity is the mental space for memory and processing (Case, 1992).

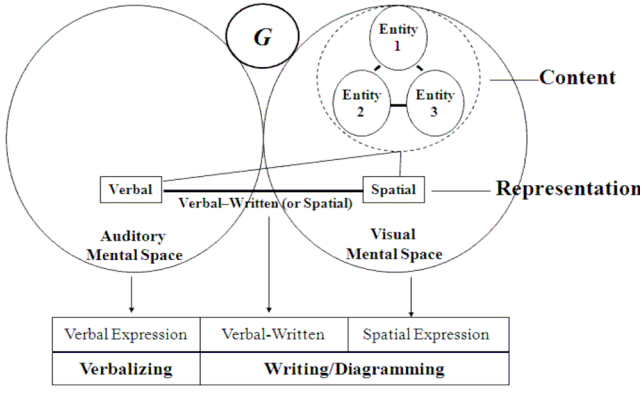


[Figure 1] The integrated model of human abilities (Song & Porath, 2005, p. 242)
Note. This is a two-dimensional representation of a multi-dimensional model.

In the model, when an individual "works" with domain stimuli, his or her g appears domain-specifically. Any domain activity or performance requires a single g, with which for an individual to find relationships and connect domain stimuli, forming domain knowledge. For example, when practical stimuli are connected to each other through found relationships in mental space, the connected stimuli are practical domain (knowledge); and when linguistic stimuli are connected to each other, they are linguistic domain or knowledge. Thus, according to the model, "domain-specific abilities or intelligences," means general abilities or g in domains.

Domains, which are determined by kinds of stimuli, are classified into practical, social, and non-practical in terms of content. The first two of the content domains were identified from abilities or intelligences suggested by major models of intelligence (Carroll, 1993; Case, 1985; Case, Demetriou, Platsidou, & Kazi, 2001; Gardner, 1983; Sternberg, 1988). Practical intelligence or ability (Sternberg, 1988) is related to daily material stimuli or adaptation to new environments or cultures. Social intelligence (Case, 1992; Gardner, 1983; Sternberg, 1988) is related to human minds or knowledge of human mental states. For example, daily material entities such as food, clothes and shoes are practical stimuli; human minds including delight, sorrow, and gloomy are social stimuli. Idealistic intelligence or ability, which is one of non-practical intelligences, was added from the analysis of abilities of gifted students; gifted students also exhibit exceptional levels of idealism.

Content stimuli are represented by auditory, visual, olfactory, taste, or tactile stimuli in an independent or integrated manner, which are representation stimuli. Visual stimuli, for instance, may be visually processed and connected and formed as visual arts in an independent manner, and auditory and visual stimuli are integrated into language (Figure 2). Language is both phonological/verbal (i.e., auditory) and spatial/written (i.e., visual). Most of the cognitive

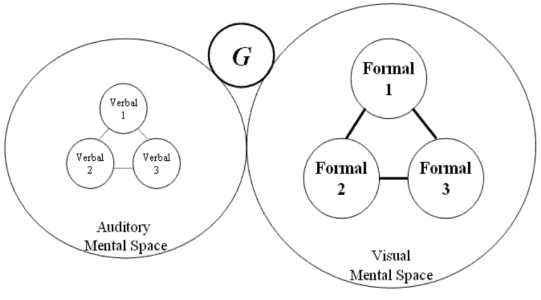


[Figure 2] Representation of content (Song & Porath, 2011, p. 218).

activities are integrated domains (e.g., reading, writing, or math). Mathematical stimuli are integrated because auditory and visual functions are required in dealing with mathematical problems. Projected on this, it cannot be said that most of the Gardner's intelligences are independent; they are integrated intelligences in his term. In the meantime, integration ratio of a domain is different from each other. Some domains require more auditory functions than visual functions (e.g., language-related), others require in the opposite way, and still others require them in an equal manner. Language requires high auditory functions (Gardner, 1983). Even in the same domain the ratio varies: Some of mathematical activities need more linguistic abilities and others require more spatial abilities (e.g., geometry), for example.

Uneven cognitive profiles within an individual can happen not by independent intelligences but by mental space in the brain where stimuli are stored and processed (Song, 2010; Song & Porath, 2011). The mental space grows with age and limits the development of cognition (Case, 1992); the growth of mental space allows increase in memory (e.g., short-term and working memory) and processing. Weak memory and processing limits the function of g, resulting in poor domain activities and performance in mental space. This is the case of LD or GLD students who show weak specific domain memory and processing, achieving much lower levels of specific domain performances, compared to their potentials.

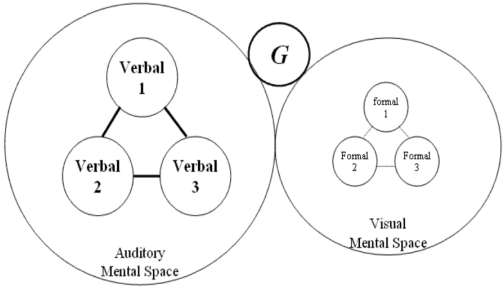
In theory, three types of GLD can exist depending on different sizes of mental spaces. The first type is when an individual has small auditory mental space with normal or larger visual mental space (Figure 3). Gifted individuals with this type of mental spaces direct less attention to auditory mental space (auditory internal attention deficit), resulting in poor auditory memory and processing, and accordingly poor learning and achievement in auditory (e.g., listening) and auditory-predominant domains that require more auditory-sequential memory, attention and processing (e.g., phonological reading and writing). This cognition refers to verbal-LD. On the other hand, this type of gifted individuals can show high abilities in non-practical domains such as creative, imaginary, idealistic, and in domains that mostly require visual-spatial functions



[Figure 3] Verbal-LD (Song & Porath, 2011, p. 224).

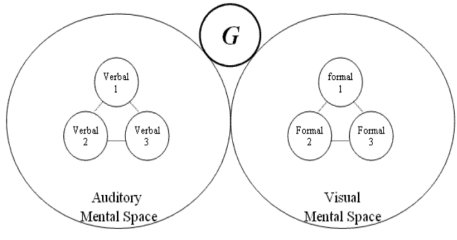
because strong internal attention direction enables them to think well in the visual mental space.

The second type is in opposite combination, small visual mental space and normal or larger auditory mental space (Figure 4). Gifted individuals with small visual mental space direct less attention to visual mental space (visual internal attention deficit), causing poor visual memory and processing and finally poor learning and achievement in domains that require high visual functions (e.g., visual arts, geometry). This cognition refers to non-verbal LD. This group of gifted individuals can show the opposite cognitive profiles to the above verbal LD: high abilities in auditory-verbal-related and practical domains because more attention is directed to the auditory mental space and practical entities in the real world space.



[Figure 4] Non-verbal LD (Song & Porath, 2011, p. 224).

The last type is a case that gifted individuals have small sizes of both auditory and visual mental space (Figure 5). They may show poor learning and achievement in every domain that requires high auditory or/and visual or visual functions because of weak internal attention direction, and accordingly weak auditory and visual memory and processing. They can be termed as verbal and non-verbal LD. Those who belong to this type can show high abilities in domains that are not related to practical or non-practical entities or ideas (e.g., social, spiritual) because they direct more attention to entities in the real world that are not practical or non-practical entities (e.g., human minds).



[Figure 5] Verbal and Non-verbal LD (Song & Porath, 2011, p. 224).

Given that domain consists of content and representation, domain thoughts of gifted and GLD students may be understood better in both terms of content and representation. Even GLD students who suffer in language-related (e.g., reading, writing) or/and mathematical activities that need auditory-sequential abilities (Bender, 2001) may show strong concentration on activities that deal with domain content of their interests. As Gardner (1983) pointed out, content is as important as representation skills. If there is no content, there is no representation, and giftedness is related to content, not representation (Song, 2009).

III. Method

1. Participants

Twenty students identified as gifted or GLD participated in this study. Ten gifted students with LD were matched for age and gender with 10 students identified as gifted (Table 1). They were selected from Grades 3 to 12. The students attended schools in two large western Canadian cities. There were nine males and one female in each group. The average age of the GLD students was 152.1 months (12.68 years) and that of the gifted students was 145.9 months (12.16 years).

<Table 1> Participants' Grade, Sex and Age

GLD			Gifted		
Grade	Sex	Age in months	Grade	Sex	Age in months
3	M	95	3	M	103
3	M	108	3	M	109
5	M	122	5	M	125
6	M	141	6	M	138
7	F	149	7	M	150
7	M	150	7	F	146
9	M	168	9	M	171
10	M	180	10	M	166
12	M	204	12	M	173
12	M	204	12	M	178

The gifted students met the local school boards' criteria of advanced intellectual ability (e.g., IQ above 130) and achievement (e.g., 99%, or three or more grades above grade level) and attended one of three programs. Each school board defined giftedness as advanced intellectual ability and achievement. The definitions include, as commonalities, demonstrated or potential cognitive abilities and performance (or achievement) that are exceptionally advanced. However, each used somewhat different indicators of ability and achievement, as described

below. Some children attended elementary multi-age classes for gifted children. Criteria for inclusion in these classes are typically reading and math skills three or more grades above grade level; at least two standard deviations above the mean on cognitive ability tests; demonstrated ability to focus on tasks; enjoyment of complexity and marked motivation to learn quickly and to learn advanced material. Others attended elementary challenge programs for gifted and highly able students in grade 3 to grade 7 and were identified by their teachers (teachers with strong knowledge of gifted children) as gifted. Criteria for inclusion in these programs are interest in independent research and demonstrated advanced levels of conceptual development through questions, products, ideas and analytic and creative thinking. The adolescents attended an accelerated program to prepare them for early university entrance. Entrance criteria for the program are academic strengths at the 99th percentile as well as organization and time management skills, personal resilience and stamina and commitment to early university entrance.

Adolescent students identified as GLD (14 to 17 years) attended a private school for students with learning disabilities. The criteria for identification as GLD is an IQ of 130 or above on an individual, standardized intelligence test and learning disabilities in oral language, written language, and/or reading. Younger GLD students (7.9 to 12.5 years) were teacher-identified using a district checklist of characteristics of gifted/learning disabled students and attended a challenge program for GLD students. They also exhibited learning disabilities in oral language, written language, and/or reading.

Teacher nomination was part of the identification process for all the students. In all but the challenge programs, formal testing using standardized intelligence (WISC-III, Wechsler, 1991) and achievement (WJ III ACH, Woodcock, McGrew, & Mather, 2001) tests also were done. In the challenge programs, teacher nomination by the classroom teacher and the challenge teacher is the primary method of identification.

The gifted and GLD students were recruited by sending a notice to parents of all eligible students in the programs. Only students whose parents consented and who themselves assented to participate in the project were included.

2. Research Tasks

The interview (conceptions of literacy) was developed by Porath (2009) following the format of Bickerton's (1994) interview on learning. It also was administered in a semi-structured format and was done in the second research session with each participant. Participants were asked to respond about reading, writing, and math (“Describe what reading/writing/math means to you. What is happening when you are reading/writing/doing math?”) and their preferences for being taught these subjects (See Appendix A).

3. Procedures

Participants were interviewed individually in a quiet room at their school. Their responses to the questions were audiotaped and then transcribed for analysis. Each interview took 20 to 30 minutes. Coding of the data was done by the researcher. An independent coder with background in education coded the same data set using the coding categories. The agreement between the two raters was 97%.

4. Analysis

The interview data were content analyzed for domain thoughts in terms of content and representation suggested by the theoretical model (Table 2). In content, practical domain thoughts refer to those of material entities or ideas that are useful in real life situations; and non-practical domain thoughts refer to those of idealistic (e.g., justice, fairness), and imaginary or creative (e.g., math, story) entities or ideas. In terms of representation, auditory domain thoughts refer to those of auditory stimuli in reading, writing, and math; and visual domain thoughts refer to those of visual stimuli in those activities.

Analysis focused on determining how the two groups of gifted students talk about domain thoughts in academic activities such as reading, writing, and math, in particular, and how their domain thoughts in those activities may differ. For these purposes, domains were identified according to domain representation and content, and the frequency of domain thoughts students showed was counted.

Analysis was done with the responses to all the following questions about reading, writing, and math: Describe what reading (or writing, math) means to you; what is happening when you are reading (writing, doing math)?; how would you like someone to teach you reading (or writing, math)?; if you could teach reading (or writing, math) to your class, what would you do?

The responses were analyzed with consideration of the whole context according to the coding criteria for domain thoughts in terms of content [i.e., practical (P-c) and non-practical (NP-c) domain entities or ideas] and representation [i.e., auditory (A-r) and visual domain stimuli (V-r)]. In content, for example, “You can use it to get a job,” was coded as ‘P-c’ (practical thought). “I just write for fun” was coded as ‘I-c’ (non-practical thought). In representation, “I do a lot of listening” was coded as ‘A-r’ (auditory thought). “I love to think visually in my mind” was coded as ‘V-r’ (visual thought).

The responses that implied domains were considered as domain thoughts, even when the responses were not expressed with preference indicators (e.g., like, love, prefer) Domain thoughts in gifted and GLD students are described in relation to domain representation and content shown in each academic activity. More specifically, domain thoughts of gifted and

GLD students in reading, writing, and math were tallied across the two groups and academic activities.

Considering that the present term, gifted students, refers to those who are gifted in academic domains at school and GLD students refers to those who are learning-disabled in academic settings, the social domain is not dealt with in this study. In representation, the present research is focused on auditory and visual domains, which are allegedly two major modes of intellectual functioning (Springer & Deutsch, 1985) related to giftedness; taste, olfactory, and tactile stimuli are excluded in this study.

<Table 2>. Domain Thoughts

Content domains		Representation domains	
Practical	Non-Practical	Auditory	Visual
Thoughts of practical entities or ideas	Thoughts of non-practical entities or ideas	Auditory-verbal thoughts	Visual-spatial thoughts

IV. Results and Discussion

1. Domain Thoughts in Gifted and GLD Students

The two groups of gifted students showed domain thoughts in content and representation (Table 3). However, the groups showed the thoughts in different ways. Gifted students expressed practical (n=31) and non-practical (n=24), and auditory (n=13) and visual (n=12) thoughts in a more balanced manner, whereas GLD students showed large discrepancies between practical (n=5) and non-practical (n=20), and auditory (n=7) and visual (n=43) thoughts. In contrast to gifted students, GLD students showed much weaker practical (n=5) and auditory (n=7) thoughts. In addition, only GLD students showed strong emotional

<Table 3> Domain Thoughts of Gifted and GLD Students

Student	Domain		Reading		Writing		Math		Total	
			Gifted	GLD	Gifted	GLD	Gifted	GLD	Gifted	GLD
1	Con.	P	2		1				3	
		NP		2	1			1	1	3
	Rep.	A								
		V		2		2				4
2	Con.	P	1						1	
		NP	1		1		1	1	3	1
	Rep.	A	1	1	1		1		3	1
		V	1		1	1	1		3	1

3	Con.	P	2		2		1		5	
		NP	1					2	1	2
	Rep.	A								
		V								
4	Con.	P	2		1			1	3	1
		NP	2	1	1			1	3	2
	Rep.	A		1		1				2
		V		3		1				4
5	Con.	P	1		1		1		3	
		NP	1	2		4	1		2	6
	Rep.	A	2	1			1		3	1
		V	1	2			2		3	2
6	Con.	P	2				1	1	3	1
		NP	2	1	1		1		4	1
	Rep.	A	3	1	1	1			4	2
		V	1	4	1	3		2	2	9
7	Con.	P	1		1	2	1		3	2
		NP	1		1	2	1		3	2
	Rep.	A								
		V		1				1		2
8	Con.	P	1	1	1		1		3	1
		NP	1			1			1	1
	Rep.	A	1						1	
		V	1	3	1	2			2	5
9	Con.	P			2		1		3	
		NP	2		1			1	3	1
	Rep.	A	1	1					1	1
		V	1	3		4		3	1	10
10	Con.	P	1		1		2		4	
		NP	2				1	1	3	1
	Rep.	A	1						1	
		V	1	3		2		1	1	6
Total			41	33	21	26	18	16	80	75

Note. Con.=Content; Rep.=Representation; P=Practical; NP=Non-Practical; A=Auditory; V = Visual

thoughts about reading, writing, or/and math in a positive or negative way. They also exhibited ambivalent attitudes in the three academic activities.

Reading. Gifted students showed domain thoughts in a more balanced manner both in content [practical (n=13) and non-practical (n=13)] and representation [auditory (n=9) and visual (n=6)], whereas GLD students showed large discrepancies between domain thoughts [practical (n=1) and non-practical (n=6)] and [auditory (n=5) and visual (n=21)]. GLD students showed weak practical and auditory thoughts, compared to their strong non-practical and visual thoughts.

I usually read non-fiction books··· getting information from certain kinds of books. (G 1)

And if it's a non-fiction, you could learn more facts···focusing on the book and looking at a picture with your eyes and you're saying the words with your mouth. (G 2)

Um, to me reading means like ··· relaxation time, fantasy, having fun. Um ··· when I'm reading I'm thinking about the characters. I'm thinking about what's going to happen next. I'm thinking about what I would do next if I was writing the story. I also try to figure out what the characters are looking like and try to draw pictures of them ··· in my head ··· or on paper. (GLD 5)

It's somebody trying to talk or communicate to you without actually speaking, like through pictures or words. I don't know ··· just kind of like an image appears ··· kind of like a diagram depending on what I'm reading. Kind of like being in a movie, whatever. It's just ··· you imagine it instead of ··· you watch it. (GLD 6)

A particular phenomenon was found in GLD students. Although it is well known that GLD students usually suffer in reading, four GLD students exhibited strong positive thoughts about reading. The number is highest among the three academic activities. In the following, the expressions of positive thoughts are italicized.

Um ··· you *get pulled into the story if it's like a fiction book* and ··· you *get interested anyway*·····. Teach them first ··· first teach them how ··· what each letter sounds what happens if it's like an a dash e and something like that and then go on to the more complicated boring stuff. (GLD 1)

Um ··· reading *means a lot to me* cause I *love reading. I love reading a lot* so···. I *just get stuck into the* book. I *can't think of anything else. When someone talks to me sometimes, I just say, "OK. That's OK with me."* I *just get* ***stuck*** *into* the book. (GLD 3)

Writing. GLD students still showed large discrepancies between domain thoughts. They showed weak practical (n=2) and auditory (n=2) thoughts but stronger non-practical (n=7) and visual (n=15) thoughts.

Uh writing is communicating in a form of symbols to read ··· uh I'm not sure cause usually I type and there just symbols on the computer and that's writing not··· it's an indirect way to communicate with other people too. Like you're expressing a form of self thought in symbols that are recognized by the community··· (G 8)

Um again its basically another form of communication you write to someone else to see if, to ··· um another form of communication, like reading··· except it's a bit more personal because if you are the one who's writing to someone else then that other person receives your thoughts and feelings, but not, whereas in a book you read someone else's ··· um···just communicate. (G 10)

The opposite of reading – trying to talk to somebody without physically talking to them. I'm trying to put down on paper what I'm thinking but I'm still trying to follow all the rules for writing. First teach you how to hold a pencil properly and maybe some basic keyboarding skills because I find that key boarding's actually fairly useful. ··· the proper way to hold a pencil which I don't do fairly well but ···. And then just teach them how different words go together and how different letters go together in words··· I think it's important for you to know how to put words together because it helps you talk. And then when you ··· when you actually ··· then maybe do some copying off the board to get used to write letters because it gives you muscle support. (GLD 6)

Writing is taking your own thoughts and arranging it on paper in the text format. I am taking thoughts that go through my head and I'm converting it into symbols on a page that someone else could then read and analyze··· Well, teach how to write like personally as opposed to just analytically, if that makes any sense. I would teach them writing through I'd use a lot of pictures. I think a lot of people are really visual learners, I think if you show them pictures of the writing and they process them, make them visualize and it'll help them get pictures that they have in their head onto paper in a text medium. (GLD 9)

In contrast to the highest number of positive thoughts about reading (n=4), GLD students showed the highest number of negative thoughts about writing (n=6). Only two negative thoughts about math were identified. In the following, the expressions of negative thoughts are italicized.

Mm, mm, mm, mm ··· *I get tired and bored. I don't* know why *I don't like writing.* No, *I just don't.* I like typing better. Um, yeh ··· and I have to like make it so neat. *I don't like* ··· well when I say *I don't really like to pick up that pencil··· I feel like writing was never invented!* (GLD 1)

Practically nothing. I don't like writing. I just don't like it. Sigh. I just get bored. Look for other things to do. I think it's just ··· I *just get bored with the actual writing*. Yeh. That's *boring* ··· what bores me. (GLD 3)

Math. The coherent phenomenon that the GLD group showed much larger discrepancies between domain thoughts was found in math as well. They rarely showed practical (n=2) and auditory (n=0) thoughts in contrast to non-practical (n=7) and visual (n=7) thoughts.

> Math means using all kind of numbers, colors, and patterns to describe a pattern of colors, plus and minus what the sum is, and you can also measure things. You're thinking all the numbers with your brain and some people think how to do them in their head. Some people say them and some people use their fingers. (G 2)

> Math is something that's very important in life. You use it every day. I think it's very important because without math we won't be able to do accurate things like launching a space craft. My brain's always thinking whether it's right or wrong and always double-checking. (G 3)

> Something very cool and interesting. It's the only thing I got a ··· on my second report card. Once you learn how to do multiplication or division you just speed through like mad. Start with 1 + 1 and then do 2 + 2 and I just keep on doubling and doubling until you reach like 64 + 64 which is 32 + 32 which is ··· 16 + 16 which is 8 + 8 which is 4 + 4 which is 2 + 2 which is 1 + 1. And 64 + 64 is 128 and then it's 236 and then ··· did I say 236? And then it's 400 ··· 472, I think. I'd just do that. You know what's weird? In Grade 1, they usually study 12 X 12 which is overly simple – it's 144. They just study that one to make like, get people impressed but they wouldn't probably know 7 X 6 which is 42. (GLD 1).

> Math is taking numbers and processing them to come up with viable results. You're taking values of things and you're manipulating them, I guess, in certain ways to get something different than what you had before. I'd like someone to teach me math though, again, through pictures, something I can see and perceive as opposed to just numbers. I would, well like I said, I would use a lot of problem, a lot of examples with a lot of visual things so that they could understand what's happening better. (GLD 9)

2. GLD Students' Ambivalent Attitudes

Unlike the gifted group, the GLD group showed contradictory emotional thoughts about reading, writing, and math (i.e., positive and negative). They show them in two ways. GLD students showed the thoughts across reading, writing, and math and show variability between individuals. Some GLD students expressed very strong positive thoughts in reading but very strong negative thoughts in writing and math. Other GLD students expressed positive thoughts

in reading and math but negative in writing. The following is an example of a GLD student (GLD 3) who showed very strong positive thoughts about reading but negative thoughts about writing and math. In the following, the expressions of positive and negative thoughts are italicized.

> Um ··· reading *means a lot to me* cause I *love reading.* I *love reading a lot* so···. I *just get stuck into* the book. I *can't think of anything else. When someone talks to me sometimes, I just say, "OK. That's OK with me."* I *just get stuck into* the book.
>
> *Practically nothing.* I *don't like writing.* I *just don't like it. Sigh.* I *just get bored. Look for other things to do··· just get bored* with the actual writing···That's *boring* ··· what *bores* me···"Write a three page essay on who founded the Bering Strait. You have until ··· and if it was Monday, you have until Thurs ··· you have until Wednesday."
>
> *Particularly nothing*, except division. Division is ··· I like division the most. I used to ··· I used to not know how to do division so ···. Uh huh... Same thing as writing. I just get bored··· No, not my favourite.

GLD students also showed ambivalent thoughts even within an academic activity. This phenomenon was found all in reading, writing, and math. In the following, the expressions of positive and negative thoughts are italicized.

> Um ··· *you get pulled into* the story if it's like a fiction book and if it's a nonfiction book you *get pulled into* it ··· *you get interested* anyway. Teach them first ··· first teach them how ··· what each letter sounds. And then teach them rules like the ch like and ed and those kind of things. And then teach them what happens if it's like an a dash e and something like that and then go on to the more complicated boring stuff and on go on to the really *boring and complicated stuff.* Overly *long words···* (GLD 1)
>
> I get ··· sometimes I get *really interested* in the book and sometimes *I don't.* Interested in the title ··· sorta. If they needed to teach me reading, you mean? (Yes). That's hard. If you could teach reading to your class, what would you do? I would ··· teach them different *sounds* of the words and everything. (GLD 2)
>
> What writing means to me is putting your thoughts down on paper so that other people can see what you're thinking. It also means *having fun* with my friends because me and my friends write stories with each other. Me and a few other numbers in the class are doing that right now. Also writing can mean putting information down in another form

so other people could find out about that and learn. Or it can mean creating new people in a whole new place, whole new lifetime, whole new time completely. And I'm using my *creative juices* ··· juice ··· I *didn't like* that very much because I *have trouble with writing* sometimes. (GLD 5).

Particularly nothing, except division. Division is ··· I *like division* the most. I used to ··· I used to not know how to do division so ···. Same thing as writing. I *just get bored.* Naw, I *don't think I would.* Yeh. Except for my mom. She's an expert at math. She knows all the little tricks and stuff. To her, Math is *like a game*. 1 X 1··· no 1 + 1 is 2; 2 + 2 is 4; 4 + 4 is 8; 8 + 8 is 16; 16 + 16 is 32; and on and on. ··· 64, 128 ··· oh God. Yeh, pretty much. Um, sort of sort of. But still it's *not my favourite.* (GLD 3)

What writing means to me is putting your thoughts down on paper so that other people can see what you're thinking. It also means *having fun* with my friends because me and my friends write stories with each other. Me and a few other numbers in the class are doing that right now. Also writing can mean putting information down in another form so other people could find out about that and learn. Or it can mean creating new people in a whole new place, whole new lifetime, whole new time completely. And I'm using my *creative juices* ··· juice ··· I *didn't like* that very much because I *have trouble with writing* sometimes. (GLD 5).

V. Conclusion and Discussion

As an empirical test of integrated model of GLD (Song & Porath, 2011), this study investigated domain thoughts of gifted students and gifted students with LD in reading, writing, and math. The results showed that gifted students exhibited strong practical and non-practical, and auditory and visual thoughts in a relatively more balanced way, whereas GLD students showed much weaker practical and auditory thoughts, compared to non-practical and visual thoughts. They exhibited large discrepancies between domain thoughts. Gifted students may verbalize and visualize practical and non-practical contents in a more balance manner while performing reading, writing, and math, whereas GLD students may be more likely to visualize and prefer to deal with non-practical contents such as creative, imaginary, or funny stories. The results also showed that only GLD students showed ambivalent attitudes between and within the academic activities. Therefore, it may be concluded that gifted students, who are highly proficient in both auditory and visual functions, can show high abilities in every domain (i.e., all-rounded), whereas GLD students can suffer in specific or all learning domains because they are weak in auditory-verbal or/and visual-spatial functions.

The results of this study are consistent with previous studies suggesting that the reason that LD students suffer in reading, writing, or math is that they have problems in phonological functions (Richek, Jennings, Caldwell, & Lerner, 2002: Raskind, 2001; Siegel, 2005; Fletcher, 2005). Considering that school learning is highly related to reading, writing, and math that require high verbal ability as well as spatial ability, GLD students with poor auditory functions (e.g., memory and processing) are more likely to suffer in school learning. Nevertheless, the result that GLD students showed strong visual thoughts is lined with the findings that GLD students show high visual-spatial abilities; they show high abilities in geometry, graphics, art, music, poetry, despite their poor performance in reading, writing, or/and math (Silverman, 1989a: 1989b; Munro, 2002).

The individual differences shown by gifted and GLD students are also lined with previous studies finding out that even gifted students demonstrate considerable variability across academic activities (Matthews, 1997). They show disparities between verbal and spatial scores; some are more auditory-verbal and others are more visual-spatial (Winner, 1996). Nobody shows even cognitive profiles in multiple intelligences (Gardner, 1983). Every LD student does not show same difficulties in reading, writing, and math (Graham & Harris, 2005).

According to the GLD model, the diverse variability between and within domains results from the degree of the discrepancy between domain functions and differences in integration ratio. The between-domain variability of GLD students can be explained by individual differences in degree of auditory and visual functions. The discrepancy between the two functions may vary among GLD students. The within-domain variability can be explained by differences in the integration ratio. The integration ratio may vary even within a domain. Some activities in a domain require more visual-spatial functions than auditory-verbal one, and others require those functions in the opposite way. Still the discrepancy varies in a spectrum.

More specifically, reading requires visual imagination about content that is represented in phonological written form (i.e., auditory and visual); children's imaginations often move into a mental space based on what they read (Meek, 2003). Reading is basically intended for content; books are read for content, not representation itself. Nonetheless, phonological written representation is instrumental to thinking about content in reading. Therefore, GLD students, who rarely show auditory domain thoughts, can have negative experiences in reading. However, the fact that GLD students also showed positive thoughts in reading may be related to their high visual imagination; readers can understand a story without necessarily processing all the words in it (Gardner, 1983).

The reason that GLD students showed the highest number of negative thoughts in writing among the three academic activities can also understood in the same context. Writing is the reverse process of reading in that reading is a process in which phonological written language

is used to approach content, but writing is a process in which content is translated into phonological written language. Accordingly, writing may require more auditory-verbal than visual-spatial representation functions. Unlike reading, all the words need to be verbally or phonologically processed in a sequential manner as well as visually processed in a wholistic manner when writing; auditory-sequential abilities are needed in spelling (Munro, 2002; Silverman, 1989a; 1989b; 1993). Thus, compared to gifted students who can show high ability in auditory and visual domains in an independent or integrated manner, GLD students, who can show high ability in visual-dominant domains, are more likely to express negative thoughts about writing. The fact that all of the GLD students who expressed negative thoughts in writing showed positive thoughts in reading may reflect the difference between reading and writing. LD in written expression is more common than in reading or math (Mayes & Calhoun, 2007).

Math may also involve auditory and visual domain representation functions at the same time. Math requires visual-spatial abilities (Ackerman et al., 1986) and auditory-verbal abilities (Cawley et al., 1979; Jordan et al., 1996); and numerical problem solving such as addition or subtraction needs verbal-sequential abilities (Bender, 2001). Considering that math may require both domain thoughts in representation, GLD students can have contradictory thoughts in math. GLD students, who rarely showed auditory domain thoughts, are likely to alternatively show positive or negative thoughts about math, depending on the integration ratio between the two domain functions. In mathematical fields in which auditory-numerical aspects override visual-spatial aspects, GLD students may have difficulty, but in the opposite situation, they may not. The fact that a GLD student showed negative thoughts in math because of his trouble with writing may be in line with this.

The positive attitudes shown by GLD students across and within reading, writing, and math can also explained in terms of the idea of content that suggested by the GLD model. The academic activities deal with content, which are represented verbally or/and spatially. As a result, GLD students may be positive when they deal with non-practical contents such as imaginary, creative, or funny things in those academic activities. The fact that some GLD students in this study who showed strong positive thoughts in reading, writing, or/and math made frequent descriptions of non-practical thoughts (e.g., funny writing exchange with friends, funny math trick or game) may support this.

This study may have important implications for identification and education of GLD students. Domain thoughts can be used in two ways in identifying GLD students. Firstly, domain thoughts can be used to identify giftedness. Domain thoughts may be used to determine domains of interest and strength among gifted students. Gifted level of relationships (g) in knowledge or performance (general thoughts) can be found better in preferred domain

content thoughts of gifted students (e.g., pratical, social, or/and non-practical). Domain thought can also be used to identify LD. Since LD result from small mental spaces, the best and simplest way to identify pure LD (i.e., without environmental influences such as experience or learning), is by measuring auditory and visual domain memory and processing. In education, for integrated domains such as reading, writing, and math, complementary functioning between representation and content is helpful for their learning. As shown in reading, if content is very interesting, creative, imaginary, or idealistic, and it requires high visual imagination, GLD students may be motivated more positively about the learning activity. Even in writing, where GLD students expressed the largest number of negative thoughts among the three academic activities, involving non-practical domain content (e.g., abstract, funny, imaginary, creative, idealistic) into writing, may help them to become interested in writing activity. In addition, visual materials or visualizing may help GLD student to engage with writing more positively. A GLD student who expressed the need for visual mediation in writing may be an example of this (e.g., teach writing through pictures; show them pictures of the writing and make them visualize; help them get pictures in their head onto paper in a text medium). In math, if teachers provide GLD students with interesting tricks and funny aspects of math or visually represented skills, they may show more active engagement or achievement.

For GLD students, non-practical content and visual representation seem critical to their thinking and learning. GLD students who face much difficulty in integrated domain knowledge should be advised to invest their effort into domain knowledge or performance which requires non-practical and visual-spatial domain thoughts (e.g., cosmology, law, politics, ethics in content, and art, geometry, geography, architecture, computer graphics and games in representation). They also could be advised to invest their time and energy in integrated domain knowledge or performance in which non-practical and visual-spatial domain thoughts are stressed. Great figures in history such as Einstein and Newton, who are considered as LD (Fetzer, 2000), may be some of good examples on the education of GLD students.

Meanwhile, despite the various approaches to teaching GLD students, their learning problems may still remain since having only interests in visual domains may not guarantee substantial performance in school learning due to low practical and auditory-verbal domain thoughts that are essential to school learning. However, this study may suggest a way by which GLD students can compensate for their LD to a certain degree in their school learning. Considering that intelligence is related to dealing with relationships, GLD students, who have high g, may be best helped with school learning when they are allowed to think about or deal with relationships. Even linguistically represented facts or ideas in school may be held more strongly in memory when the facts or ideas are connected to problems or phenomena in real life or those kept in their memory rather than when they simply hold the facts or ideas in

their memory in the same way as they are presented. (This may be the way GLD students can compensate for their LD, unlike students who are LD but whose intelligence is not as high.) This makes GLD students' prior or existing knowledge explicit, and their prior knowledge is associated with new facts or ideas in a complex manner. Knowing what they know makes children's further learning easier (McKeough & Sanderson, 1996). GLD students like to learn in a more complex and sophisticated way (Coleman, 2005).

This empirical study may have a limitation in the number of its participants. Ten gifted students and another 10 GLD students respectively participated in this study. Thus, more data need to be added to ensure generalization of the results. Considering this study's suggestion that LD results from weak specific domain functions (e.g., memory and processing), future research can be extended to an investigation of how other types of GLD students (e.g., non-verbal GLD, verbal and non-verbal GLD) show domain thoughts in academic activities. Finally, to get a deep and full understanding giftedness, it will be intriguing to study what the general thoughts (i.e., relationships in domain thoughts) are and whether both groups of gifted students commonly show high level of general thoughts.

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= Abstract =

영재와 학습장애영재의 영역적 사고

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이 논문은 학습장애영재 모델(Song & Porath, 2011)의 실증적 검증 차원으로, 읽기, 쓰기, 수학에서 학습장애가 없는 영재와 학습장애영재가 보이는 영역적 사고를 조사하였다. 두 그룹의 영재들로부터 인터뷰 자료를 수집하였고 분야적 사고 측면에서 분석하였다. 그 결과 영재는 읽기, 쓰기, 수학에서 비교적 균형 잡힌 영역적 사고를 나타낸 반면 학습장애영재는 특정 분야에서 약한 영역적 사고를 보였다. 뿐만 아니라 오직 학습장애영재만이 읽기, 쓰기, 수학의 각각의 분야 내에서 서로 상반된 태도를 보였는데 그들은 같은 분야 내에서 긍정과 부정의 감정을 동시에 드러냈다. 이 논문은 학습장애영재 모델에서 제시하고 있는 인지 메커니즘을 통해 두 영재 집단의 차이점들을 설명하고 영재 선발과 교육에 대한 새로운 접근 방법을 제안하고 있다.

주제어: 지능, 분야, 영재, 학습장애, 학습장애영재, 이중특수아

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<Appendix A>

Conceptions of Literacy

Describe what reading means to you.
What is happening when you're reading?
How would you like someone to teach you reading?
If you could teach reading to your class, what would you do?
Why would you do it that way?
Describe what writing means to you.
What is happening when you're writing?
How would you like someone to teach you writing?
If you could teach writing to your class, what would you do?
Why would you do it that way?
Describe what math means to you.
What is happening when you're doing math?
How would you like someone to teach you math?
If you could teach math to your class, what would you do?
Why would you do it that way?