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University Students' Visual Cognitive Styles with respect to Majors and Years

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Visual cognitive style is an individual difference that is related to the preference or visual imagery tendency of an individual of processing visual information. This study examines the visual cognitive styles of university students according to their study subject, study year and genders and includes 448 first- and third-year university students from seven departments. The results indicate that spatial imagery tendencies were stronger among students in the sciences, whereas verbal tendencies were strong among students in linguistic fields. The spatial imagery tendencies of third-year students from the Department of Physics Engineering and the verbal tendencies of third-year students from the Department of English Language Teaching were significantly higher than those of first-year students of related departments. Different from previous studies the finding about the tendency increment among first to third year of study is remarkable which can be investigated through experimental studies.

Keywords: object imagery, spatial imagery, visual cognitive style

INTRODUCTION

Individuals display better performance with learning processes based on an educational design that takes into account individual differences (Mayer, 2001). The research indicates that learning environments increase learning efficiency by addressing learners who have different cognitive styles (Riding & Sadler-Smith, 1992; ChanLin, 1999; Hegarty & Kozhevnikov, 1999; Massa & Mayer, 2006; Grimley, 2007; Höffler, Prechtl, & Nerdel, 2010; Thomas & McKay, 2010; Höffler & Schwartz, 2011;) support the need for research investigating cognitive style. In the context of this need, 92% of cognitive style researchers have stated that they conduct studies in the field of style to increase educational success level through experience and to develop the process and learning outputs (Peterson, Rayner, & Armstrong, 2009).

Cognitive style refers to consistent individual differences in preferred ways of organizing and processing information and experiences (Messick, 1976, s.5; As cited in Allinson & Hayes, 1996), and it is defined as an individual's way of organizing and representing information, which is preferred by the individual and to which that

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individual is accustomed (Riding & Rayner, 1998). Within the scope of the study conducted to determine the perceptions of cognitive style researchers about cognitive style, the researchers agreed on the definition of "Cognitive styles are individual differences in processing that are integrally linked to a person's cognitive system. More specifically, they are a person's preferred way of processing (perceiving, organizing and analyzing) information using cognitive brain-based mechanisms and structures. They are partly fixed, relatively stable and possibly innate preferences" (Peterson, Rayner, & Armstrong, 2009).

The visual cognitive style, which is discussed as an individual difference in terms of cognitive style, is related to the preference of an individual of processing visual information (Yoon & D'Souza, 2009). The earliest studies of visual cognitive style, which centered on the concepts of mental imagery and mental representation, asserted that some individuals predominantly represent information verbally, whereas others represent information as more visual or imaginary. The starting point of studies about visual cognitive style consists of studies categorizing individuals as visual–verbal (Paivio, 1971; Richardson, 1977). The dual-coding approach dealing with the measurement of mental imagery (Paivio, 1971) categorizes individuals as visual and verbal and asserts that verbal individuals primarily use their verbal-analytical strategies, whereas visual individuals primarily use their visual imageries when conducting a cognitive task.

State of the literature

- Individuals from different fields show imagery tendencies that are related to their fields and show better performance to imagery tasks that are related to their cognitive styles.
- The learning environments are found more effective that are prepared by considering different cognitive styles or imagery tendencies.
- While various tasks or situations require different tendencies and skills, determining cognitive styles or preferences will give opportunity to educators to improve learners to overcome their weaknesses in learning tasks.

Contribution of this paper to the literature

- This research shows that visual cognitive style changes not only by the gender but also by the study subject and study year.
- Different from previous studies, the tendency change by study year is examined and founded that study year has significant effect on visual cognitive style which should be discussed within cognitive style definition.
- Experimental studies investigate the effect of education on visual cognitive style and imagery tendency will present valuable findings.

Imagery is the registration of existing stimuli or the perception of the information remembered. Beyond the imagery, visual mental imagery refers to the ability to see in the absence of the appropriate instant sensory input (Kosslyn, 1995). According to Kosslyn (1995), there are two objectives of imagery: recalling information from memory and guessing physical changes in parallel with vision. Mental representations are connected with experiential, behavioral and psychological changes of an individual, and individuals experience the relative invariable differences of preferences for the representation of information (Richardson, 1994). Individual style comprises the apparent tendency for preferentially using one condition of representation over the other as well as having the ability to use every condition of mental representation (Riding & Cheema, 1991).

Visual individuals may primarily trust their images when carrying out cognitive tasks, whereas verbal individuals primarily rely on their verbal analytical strategies (Kozhevnikov, Kosslyn, & Shephard, 2005), which should not result in the presenting of only text-based or image-based materials in line with learner preferences. Robertson (2003) asserts that individuals who have visual tendencies are better at remembering words or sentences that are easily imaged, whereas the individuals who have verbal tendencies remember sentences which are relatively difficult to image. Based upon this finding, it is emphasized that both visual and verbal skills should be used and that selecting one of these skills and ignoring the other causes a problem. It is also underlined that the difference in representing information via visual imagery or verbal words while thinking affects the learning

performance of the individual (Riding and Taylor, 1976; As cited in Riding & Rayner, 1998). In addition, the findings of a study that had implied two conditions as mainly diagram-based and mainly text-based revealed that learners who had a visual tendency do not necessarily perform better with mainly diagram-based materials (Kollöffel, 2012).

There are two approaches in the measurement of cognitive style: personal reporting based on introspection and information processing tests, based on the assumption that style affects performance. It is claimed that information processing tests are preferred because the scales based on introspection have inherent weaknesses (Riding, 2001, p. 49). However, the most important problem of the methods presented for measuring cognitive style is that they are inconvenient when applied to large-scale studies (Allinson & Hayes, 1996). The scales of the Individual Differences Questionnaire (Paivio, 1971) and Verbalizer–Visualizer Questionnaire (Richardson, 1977) are regarded as self-evaluation tools that focus on the difference between visual individuals who are supposed to have high imagery ability for visual cognitive style and verbal individuals who have low imagery ability. More recent theoretical studies have examined the visual dimension in two different dimensions: spatial imagery and object imagery (Kozhevnikov, Kosslyn, & Shephard, 2005; Anderson et al., 2008). Several studies have attempted taking into consideration this model to develop scales to enable categorization (Blazhenkova, Kozhevnikov, & Motes, 2006a; Blazhenkova & Kozhevnikov, 2009).

Unlike studies of visual–verbal cognitive style categorization, the Object/Spatial-Verbal Cognitive Style Model (Kozhevnikov, Kosslyn, & Shephard, 2005) examines the visual dimension via two sub-dimensions, termed the object-visual and spatial-visual by Object-Spatial Imagery Scale (OSIQ). According to the model, whereas some visual individuals are good at constructing vivid, pictorial and detailed images of objects, others are better at representing spatial relationships between objects and animating spatial transformations in their imagery. It has been stated that verbal individuals prefer to process and represent information verbally and are better at carrying out verbal tasks. It was found that object-visual individuals have a more holistic approach and are better at defining the general view of shapes, whereas spatial-visual individuals are more successful in defining divisional characteristics. Object imagery corresponds to the representations of invariable characteristics of individual objects such as form, size, shape, color and brightness; spatial imagery corresponds to the relative abstract representations of objects, the spatial relationships between the parts of objects and other complex spatial transformations (Blazhenkova, Kozhevnikov, &Motes, 2006b).

A study of individuals with various specialties concluded that scientists and engineers tend to be spatial imagery individuals, whereas people interested in visual arts tend to be object imagery individuals (Kozhevnikov, Kosslyn, & Shephard, 2005). Visual artists who were known to use object imagery skills in their education and work scored higher in object imagery than scientists and experts in human sciences. However, scientists who were known to use spatial imagery skills in their education and work scored higher in spatial imagery than visual artists and experts in human sciences (Blazhenkova, Kozhevnikov, &Motes, 2006a). In addition to these findings on the object and spatial imagery dimensions, it was determined via Object-Spatial Imagery and Verbal Questionnaire (OSIVQ) that experts in human sciences tended toward the verbal dimension more than the other areas of expertise, supporting the verbal dimension as the third dimension of the Object-Spatial-Verbal Cognitive Style Model (Blazhenkova & Kozhevnikov, 2009). Visual cognitive style is investigated in three dimensions as spatial imagery, object imagery and verbal within Object-Spatial-Verbal Cognitive Style Model. Model indicates that in three principle, individuals who 1) have higher object imagery tendency are likely to

create pictorial and detailed images of objects, 2) have higher spatial imagery tendency are better at representing the spatial relationships between objects and creating images of the spatial transformations, 3) prefer processing and representing information verbally are better in verbal tasks. According to the model the visual cognitive style tendencies are determined via Object - Spatial Imagery and Verbal Questionnaire (OSIVQ, Blazhenkova & Kozhevnikov, 2009) which is a self-report questionnaire consists of 45 questions with equal number of questions on three dimensions. Considering results of the research studies of this model, individuals in different fields have different imagery tendencies—in other words, they have different visual cognitive styles. Also it was found that males tended to characterize themselves as spatial-visual, whereas females tended to characterize themselves as object-visual. When examined in terms of the verbal dimension, there was no significant difference by participant gender. It has been emphasised within model research that individuals who are efficient in any type of imagery may display a tendency to use this skill more frequently in daily life activities and thus launch and use only one type of imagery system and does not use the other imagery system in practice meaning a compensative mechanism (Kozhevnikov, Kosslyn, & Shephard, 2005).

The remembrance and understanding levels among students were examined using three different types of learning materials (text, text and pictures, text and schematic figures) that would address these cognitive styles. Regression analyses indicated that cognitive styles can clearly estimate learning scores for understanding when they were matched with the representation conditions of cognitive styles (Thomas & McKay, 2010). This finding demonstrates that the three different styles have independent functions and a systematic effect on learning. In another study examining three types of multimedia materials (static text and image-based material, video-based material and animated interactive material), it was found that video-based learning results in the best learning performance and most positive emotion for verbalizers, and for visualizers, video-based and animated interactive materials were more suitable than others (Chen & Sun, 2012).

Blazhenkova and Kozhevnikov (2009) emphasized the importance of identifying object-visual individuals with weak spatial skills and providing them with educational materials and technologies to aid them in establishing a connection between object and spatial representations. In other words, knowing the imagery tendencies of individuals is important for developing efficient educational methods and tools (Blazhenkova, Kozhevnikov, & Motes, 2006a).

Yoon and D'Souza (2009) presented a schematic problem to students of architecture and interior architecture. Participants were asked to interpret a cubist picture three-dimensionally and to design a corridor based on an audio track. In the resulting projects of the students, it was found that the object-visual individuals displayed a tendency for using two-dimensional details and developed simple three-dimensional simple structures. In contrast, the spatial individuals were more successful in adopting three-dimensional components in the design and did not place much emphasis on objects. The architecture students scored higher spatial-visual points when compared with the students of interior architecture. This finding indicates that the visual cognitive style tendencies of students are in compliance with their field of study.

Pitta-Pantazi and Christou (2010) examined students' spatial and object imageries in relation to their analytical, creative and practical skills in three-dimensional geometry. Individuals with a high object cognitive style according to Object-Spatial Imagery Scale (Kozhevnikov, Kosslyn, & Shephard, 2005) scores performed better in tasks related to creativity; however, there was no significant difference between the two groups for tasks related to three-dimensional creativity.

It was observed that individuals with a strong object cognitive style drew far more correct and colored cubes.

Xistouri and Pitta-Pantazi (2011) investigated the relationship between the cognitive style and transformational geometry skills, including the duties of transformation, reflection and turning. It was observed via OSIVQ that spatial imagery tendencies of students were related to the results of all transformational geometry skills tests, whereas the object imagery tendencies of students were related only to reflection and general performances. Based on the OSIVQ scores, the students having a strong spatial imagery tendency performed better in solving difficult tasks.

Blazhenkova and Kozhevnikov (2009) emphasized that it is important to examine the change in tendency of cognitive style dimensions (object, spatial and verbal) according to factors such as age, gender, experience, education, innate skills and cultural differences and also to examine the relationship between these styles. On the other hand, it is possible that object-spatial preference manifests gradually, as a result of educational practices and professional applications, including visual processing of one type for vocational fields (e.g., physical sciences, engineering) utilizing spatial imagery such as dynamic transformation of schematic images or for vocational fields (e.g., visual arts) requiring object imagery such as paying attention to the visual characteristics of the image and objects (Kozhevnikov, Blazhenkova, & Becker, 2010).

Previous studies related to this model have included specialists from different fields and students who received education in different subjects, in addition to examining the effect of gender. A literature search did not locate any previous study that examined the effect of study year on visual cognitive tendencies. Therefore, the present study focuses on the change with respect to the variables of gender and working subject, and in particular, the effect of the study year variable on the visual cognitive tendency, with the object-spatial-verbal cognitive style model as a basis.

METHOD

The study examined differences between the object-spatial imagery and verbal cognitive style tendencies of individuals. The effect of the variables of study year, study department and gender were analyzed as a causal comparative form. Descriptive statistics and one-way analysis of variance (ANOVA) was used, and also Bonferroni test results were reported.

Participants

Seven departments from a public university were selected in line with the cognitive styles predicted for students from differing fields of education, given in the framework of theoretical purposive sampling model by taking into consideration the object, the spatial and the verbal dimensions (See Table 1).

To examine the effect of the university field of education on students' cognitive styles, their study year was taken as a criterion for the stratified purposive sampling method, and the students were separated into two groups according to their departments: those who had just started to receive field education and students who had completed their third year in their field of education.

Data collection tools

The data on object imagery, spatial imagery and verbal cognitive style tendencies of the students were collected by Turkish adapted version (Nuhoğlu and Akkoyunlu, 2012) of Object-Spatial Imagery and Verbal Questionnaire (OSIVQ) which was developed by Blazhenkova and Kozhevnikov (2009). OSIVQ consists of three sub-

dimensions (object imagery, spatial imagery, verbal), and gives three cognitive style points to participants depending on the sub-dimensions.

RESULTS

Based on the guidelines for the scale, the object, the spatial imagery and the verbal scale scores of all participants were calculated by taking the arithmetic mean. Taking as the basis the ±1 sd criterion, when the raw scores of the object imagery, spatial imagery and verbal dimensions of the students were compared, it was found that the students assessed themselves higher in terms of object imagery than spatial imagery and verbal dimensions (Fig. 1). This difference corresponds with the findings of Blazhenkova and Kozhevnikov (2009).

Do the visual cognitive style tendencies of students differ significantly by gender?

The Levene F-test indicated that variances related to the object imagery (F(1, 444)=.61, p>.05), spatial imagery (F(1, 444)=.06, p>.05) and verbal (F(1, 444)=.03, p>.05) points were equal for each sample (See Table 2).

The object imagery tendencies (F(1, 444) = 8.26, p=.004; female M=3.74, SD= .58, male M=3.57, SD= .59) of females were stronger than those of males, whereas the spatial imagery tendencies (F(1, 444) = 30.63, p=.000; male M=3.33, SD= .73; female:

Table 1. Distrubution of sample by study subject, study year and gender

Departments		Study Year 1 Female	1 Male	3 Female	3 Male	Total
Interior Architecture and Environmental Design	*f*	30	4	22	2	58
	%	7.6 %		5.3%		12.9 %
Painting	*f*	11	5	7	9	33
	%	3.6 %		3.8 %		7.3 %
Physics Engineering	*f*	9	13	7	29	59
	%	4.9 %		8.2 %		13.1 %
Chemistry Education	*f*	11	10	7	7	36
	%	4.7 %		3.3 %		8.0 %
English Language Teaching	*f*	38	12	25	7	82
	%	11.1 %		7.1 %		18.2 %
Turkish Language and Literature	*f*	27	20	25	18	91
	%	10.4 %		9.8 %		20.2 %
Computer Education and Instructional Technology	*f*	28	20	16	27	91
	%	10.7 %		9.6 %		20.2 %
Total	*f*	154	84	109	99	448
	%	52.9 %		47.1 %		100 %

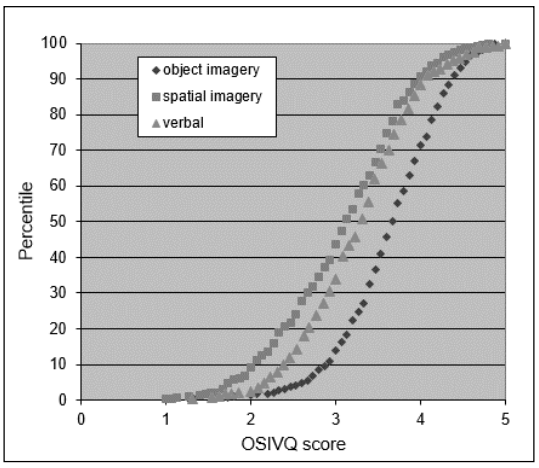

Figure 1. Distribution of the OSIVQ raw scores

Table 2. Visual cognitive style tendency variation of students by gender

	Total Group (*n*=446)		Gender					
			Female (*n*=266)		Male (*n*=180)		*F* (1, 444)	Significant Difference
	M	*SD*	*M*	*SD*	*M*	*SD*		
Object Imagery	3.67	.59	3.74	.58	3.57	.59	8.26[b]	K>E
Spatial Imagery	3.10	.74	2.94	.71	3.33	.73	30.63[c]	E>K
Verbal	3.67	.59	3.74	.58	3.57	.59	2.36	

[a]*p<.05;* [b]*p<.01;* [c]*p<.001*

Table 3. Visual cognitive style tendency variation of first-year students by departments

	Total Group (*n*=238)		Departments															
			1 (*n*=16)		2 (*n*=22)		*3* (*n*=21)		4 (*n*=50)		5 (*n*=34)		6 (*n*=47)		7 (*n*=48)		*F* (6, 231)	Significant Difference
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Object Imagery	3,70	,57	3,91	,80	3,60	,49	3,74	,54	3,74	,55	3,90	,45	3,66	,55	3,51	,62	2,240[a]	5>7
Spatial Imagery	3,02	,75	2,96	,45	3,44	,57	3,46	,62	2,75	,75	3,33	,51	2,42	,74	3,29	,61	14,06[c]	2>4 3>4 5>4 7>4 7>6
Verbal	3,29	,64	3,19	,40	3,20	,65	3,45	,40	3,07	,56	3,26	,71	3,67	,68	3,19	,61	4,67[c]	6>4 6>7

[a]*p<.05;* [b]*p<.01;* [c]*p<.001*

1 - Painting; 2- Physics Engineering; 3 - Chemistry Education; 4 - English Language Teaching; 5 - Interior Architecture and Environmental Design; 6 - Turkish Language and Literature; 7 - Computer Education and Instructional Technology

M=2.94, *SD*= .71) of males were stronger than those of females. There was no significant difference in the verbal tendencies of students according to gender (*F*(1,444) = 2.36, *p*=.125).

Do the visual cognitive style tendencies of students differ significantly between study subjects?

The participants were separated into seven groups according to departments and into two according to study years to satisfy the principle of equality of variance.

First-year students

The Levene F-test indicated that the variances related to the object imagery (*F*(6, 231)=.946, *p*>.05), spatial imagery (*F*(6, 231)= 1.849, *p*>.05) and verbal (*F*(6, 231)= 1.41, *p*>.05) points were equal for each sample. The tendency toward object imagery (*F*(6, 231)= 2.240, *p*=.04), spatial imagery (*F*(6, 231)= 14.06, *p*=.00) and verbal (*F*(6, 231)= 4.67, *p*=.00) of the first-year students varied according to their department of study (See Table 3).

Those from the Department of Physics Engineering (M=3.44, SD= .57), Chemistry Education (*M*=3.46, *SD*=.62), Interior Architecture and Environmental Design (*M*=3.33, *SD*= .51), Computer Education and Instructional Technology (*M*=3.29, *SD*=.61) had a stronger tendency towards spatial imagery than first-year students from the Department of English Language Teaching (*M*=2.75, *SD*= .75) and Turkish Language and Literature (*M*=2.42, *SD*= .74).

The verbal tendencies of first-year students from the Department of Turkish Language and Literature (*M*=3.67, *SD*= .68) were higher than those from the Department of English Language Teaching (*M*=3.07, *SD*= .56) and the Department of Computer Education and Instructional Technology (*M*=3.19, *SD*= .61).

The object imagery tendencies of first-year students from the Department of Interior Architecture and Environmental Design (*M*=3.90, *SD*=4.45) were higher than those of first-year students from the Department of Computer Education and Instructional Technology (*M*=3.51, *SD*= .62). It is notable that it was expected that the tendency toward object imagery would be stronger within the art departments; however, the tendency toward object imagery was only strong within the

departments of Interior Architecture and Environmental Design and Computer Education and Instructional Technology.

Third-year students

The Levene F-test indicated that the variances related to object imagery (F(6, 231)= .971, p>.05), spatial imagery (F(6, 231)= 1.862, p>.05) and verbal (F(6, 231)= .862, p>.05) points were equal for each sample (See Table 4).

The results indicate that there is a significant difference in the spatial imagery tendencies of students in terms of department (F(6, 205)= 23.565, p=.00). Spatial imagery tendencies of the third-year students from the Department of Painting (M=3.04, SD= .47) were stronger than those of third-year students from the Department of Turkish Language and Literature (M=2.48, SD= .58). There was no significant difference in the object imagery tendencies of the third-year students in terms of department (F(6, 205)= .40, p=.87).

Third-year students from the Department of Computer Education and Instructional Technology (M=3.39, SD= .46), the Department of Interior Architecture and Environmental Design (M=3.49, SD= .51), the Department of Chemistry Education (M=3.50, SD= .55) and the Department of Physics Engineering (M=3.81, SD= .55) had a stronger tendency toward spatial imagery than third-year students from the Department of English Language Teaching (M=2.85, SD= .74) and the Department of Turkish Language and Literature (M=2.48, SD= .58).

The third-year students from the Department of Physics Engineering (M=3.81, SD= .55) had a stronger tendency toward the spatial dimension than third-year students from the Department of Painting (M=3.04, SD= .47) and the Department of Computer Education and Instructional Technology (M=3.39, SD= .46).

The results of the analysis indicate a significant difference in the verbal tendencies of the students according to their department (F(6, 205)= 5.85, p=.00). The verbal cognitive style tendencies of third-year students from the Department of Turkish Language and Literature (M=3.72, SD= .62) were higher than those of third-year students from the Department of Painting (M=2.84, SD=.58), Physics Engineering (M=3.14, SD= .70), Interior Architecture and Environmental Design (M=3.18, SD= .71) and Computer Education and Instructional Technology (M=3.10, SD=.68).

Do the cognitive styles of students differ significantly according to their study years?

The findings of the analyses were examined between first- and third-year students of seven departments.

Table 4. Visual cognitive style tendency variation of third-year students by departments

	Total Group		**Departments**															
			1		**2**		***3***		**4**		**5**		**6**		**7**			
	(*n*=212)		**(*n*=17)**		**(*n*=37)**		**(*n*=15)**		**(*n*=32)**		**(*n*=24)**		**(*n*=44)**		**(*n*=43)**		***F*(6, 205)**	**Significant Difference**
	M	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***		
Object Imagery	3.62	.62	3.68	.76	3.63	.57	3.57	.51	3.52	.65	3.77	.59	3.63	.72	3.60	.56	.40	
Spatial Imagery	3.18	.72	3.04	.47	3.81	.55	3.50	.55	2.85	.74	3.49	.51	2.48	.58	3.39	.46	23.56[c]	1>6 7>4,6 5>4,6 3>4,6 2>4,6
Verbal	3.29	.69	2.84	.58	3.14	.70	3.34	.57	3.40	.55	3.18	.71	3.72	.62	3.10	.68	5.85[c]	6>1, 2, 5, 7

[a]p<.05; [b]p<.01; [c]p<.001

1 - Painting; 2- Physics En; 3 - Chemistry Education; 4 - English Language Teaching; 5 - Interior Architecture and Environmental Design; 6 - Turkish Language and Literature; 7 - Computer Education and Instructional Technology

There was a significant difference in the spatial imagery tendencies between the first- and third-year students from the Department of Physics Engineering. No significant difference was found in terms of the object imagery and the verbal tendencies of the students. The spatial imagery tendencies of the third-year (*M*=3.81, *SD*= .55) students from the Department of Physics Engineering were found to be significantly higher than those of first-year students (*M*=3.44, *SD*= .57). This finding is interpreted as the training received within the department developed spatial skills and thus increased the spatial imagery tendency (See Table 5).

There was no significant difference in the object, spatial and verbal tendencies of the first- and third-year students from the Department of Painting according to study year. Similar to Painting, there was no significant difference in the Department of Interior Architecture and Environmental Design in terms of student study year.

There was no significant difference in the spatial and the verbal imagery tendencies of the first- and third-year students from the Department of Turkish Language and Literature. Because the normality assumption of the one-way ANOVA was not met, the Kruskal-Wallis H-test was used, but this also indicated there was no significant difference in object imagery tendencies. Different from the Department of Turkish Language and Literature, a significant difference was found in the verbal tendency between the first- and third-year students of studying in the Department of English Language Education. The sample averages for the verbal style dimension revealed that the verbal tendencies of the third-year students (*M*=3.40, *SD*= .55) were significantly higher than those of first-year students (*M*=3.07, *SD*= .56). This discrepancy may result from the fact that the students from the Department of English Language Teaching are studying a non-native language. Within the

Table 5. Visual cognitive style tendency variation of students by study year

		Total Group		Study Year					
				1		3			Significant Difference
		M	*SD*	*M*	*SD*	*M*	*SD*		
Painting			(*n*= 33)		(*n*=16)		(*n*= 17)	*F*(1, 32)	
	Object I.	3.79	.78	3.91	.80	3.68	.76	.71	
	Spatial I.	3.00	.45	2.96	.45	3.04	.47	.27	
	Verbal	3.01	.53	3.19	.40	2.84	.58	3.79	
Interior Architecture			(*n*= 34)		(*n*= 24)		(*n*= 58)	*F* (1, 56)	
and Environmental	Object I.	3.85	.51	3.90	.45	3.77	.59	.97	
Design	Spatial I.	3.40	.51	3.33	.51	3.49	.51	1.32	
	Verbal	3.22	.71	3.26	.71	3.18	.71	.15	
Physics Engineering			(*n*= 59)		(*n*= 22)		(*n*= 37)	*F* (1, 57)	
	Object I.	3.62	.53	3.60	.49	3.63	.57	.07	
	Spatial I.	3.67	.58	3.44	.57	3.81	.55	5.74[a]	3>1
	Verbal	3.17	.68	3.20	.65	3.14	.70	.105	
Chemistry Education			(*n*= 36)		(*n*= 21)		(*n*= 15)	*F* (1, 34)	
	Object I.	3.67	.52	3.74	.54	3.57	.51	.914	
	Spatial I.	3.48	.59	3.46	.62	3.50	.55	.026	
	Verbal	3.41	.47	3.45	.40	3.34	.57	.449	
English Language			(*n*= 82)		(*n*= 50)		(*n*= 32)	*F* (1, 80)	
Teaching	Object I.	3.66	.60	3.74	.55	3.52	.65	2.85	
	Spatial I.	2.79	.74	2.75	.75	2.85	.74	.36	
	Verbal	3.20	.58	3.07	.56	3.40	.55	6.81[a]	3>1
Turkish Language and			(*n*= 91)		(*n*= 47)		(*n*= 44)	*F* (1, 89)	
Literature	Spatial I.	2.45	.67	2.42	.74	2.48	.58	.202	
	Verbal	3.69	.65	3.67	.68	3.72	.62	.167	
Computer Education			(*n*= 91)		(*n*= 48)		(*n*= 43)	*F* (1, 89)	
and Instructional	Object I.	3.55	.59	3.51	.62	3.60	.56	.599	
Technology	Spatial I.	3.34	.55	3.29	.61	3.39	.46	.668	
	Verbal	3.15	.64	3.19	.61	3.10	.68	.470	

[a]p<.05; [b]p<.01; [c]p<.001

1 - Painting; 2- Physics Engineering; 3 - Chemistry Education; 4 - English Language Teaching; 5 - Interior Architecture and Environmental Design; 6 - Turkish Language and Literature; 7 - Computer Education and Instructional Technology

Department of English Language Teaching, the stronger verbal tendency of the third-year students compared with first-year students may be because the third-year students have studied much more of the foreign language.

There was no significant difference in the object, spatial imagery and verbal style tendencies between first- and third-year students from the Department of Chemistry Education and Department of Computer Education and Instructional Technology.

DISCUSSION AND SUGGESTIONS

The aim of the study was to examine the visual cognitive tendencies of university students and was conducted with the participation of students from seven different departments via proper sampling by taking into consideration of findings regarding the effect of areas of expertise reported in the literature on imagery. Unlike previous studies, the study examined the tendencies of the students studying in the same field but in different study years, with a view toward establishing whether their imagery tendencies differentiate within study years.

Examining the results according to study subjects in parallel with the findings in the literature, it was observed that spatial tendencies were stronger among students in the sciences, whereas verbal tendencies were strong among students in the fields of linguistics and language. Students in the departments of Physics Engineering and of Chemistry Education displayed distinctly stronger tendencies toward spatial imagery, whereas those in the Department of Turkish Language and Literature displayed distinctly stronger verbal tendencies.

Unlike previous studies, no significant difference was found in the tendency of arts students in terms of object imagery. This could be the result of sample, which was composed of 12.9% Department of Interior Architecture students and 7.3% Department of Painting students. The Department of Interior Architecture was included in the sample as an art field and comprised a great majority of the sample. The majority being from the Department of Interior Architecture might be because of the student acceptance procedure differences between the Department of Interior Architecture and the other departments structured in the Faculty of Fine Arts. Whereas Faculty of Arts departments generally accept students following an aptitude exam, the Department of Interior Architecture accepts students mainly based off of mathematics and science test scores. Furthermore, Yoon and D'Souza (2009) found that architecture students had scored higher spatial-visual values than students of interior architecture, and also architecture students displayed higher spatial imagery tendencies compared with those of interior architecture students. These results indicate that the visual cognitive style tendencies of students are in compliance with their field of study. Whereas architecture and interior architecture appear to be closely related study fields, the cognitive style tendencies of the students differ by department.

The spatial imagery tendencies of third-year students from the Department of Physics Engineering were found to be significantly higher than those of first-year students. In addition, Sorby, Casey, Veurink and Dulaney (2013) found that spatial interventions are effective in raising spatial skills for engineering students and improving their grades in introductory calculus courses. Based on their findings, they assert that spatial skills are malleable and spatial interventions in science, technology, engineering and mathematics can improve the performance of, in particular, first-year students who displayed poor spatial skills.

Potential differences in imagery preference according to subject matters were tested individually between first- and third-year students; a great majority of the findings were parallel. The verbal tendency findings were remarkable. The verbal tendencies of the first-year students from the Department of Turkish Language and

Literature were found to be higher than those of students from the Department of English Language Teaching; however, this finding was not replicated among the third-year students. This difference may be because the subject matter in which the first-year students displayed a strong verbal tendency was taught in the native language of the students. In other words, first-year students who studied in their native language in the university displayed stronger verbal tendencies at the beginning of their education process compared with first-year students studying a foreign language; however, it can be stated that a verbal language education may have affected this situation. This finding should be studies in different cultures based on verbal imagery tendencies.

There was no significant difference in the object, spatial and verbal tendencies of the first- and third-year students from the Department of Painting according. It is believed that the most important factor in these similar cognitive style tendencies is that this is an arts department. Students wishing to pursue their education in the field of arts begin art-oriented studies to enter these departments during high school. Similar to Painting, there was no significant difference in the Department of Interior Architecture and Environmental Design in terms of their grades. While this department exists under Faculty of Fine Arts, students enrolled in this department have a significant artistic background prior to attending university. Thus, it can be said that students in the arts therefore gain certain—and relatively stable—cognitive style tendencies before going to university.

In addition, the analyses performed according to study year indicate the differences in the tendencies of the students in the fields of physics engineering and language are similar to those in the subjects. The spatial imagery tendencies among the third-year students from the Department of Physics Engineering were higher than those of first-year students, whereas the verbal tendencies of the third-year students from Department of English Language Teaching were higher than those of first-year students. It is notable that the departments of Physics Engineering and English Language Teaching were in the forefront within their own fields among the departments included in the study. This situation suggests that education within the departments of Physics Engineering and English Language Teaching is structured in a way that will increase and concretize the field-related tendencies of students.

On the other hand unlike from Department English Language Teaching, Department of Chemistry Education and Department of Computer Education and Instructional Technology displayed no significant difference according to study year. This will be the result of department's curriculum difference. These two departments have different subjects such as chemistry and computer science, and the curriculum structure is condensed in terms of education and does not focus the tendencies of the students toward one of the visual style dimensions. In a study examining condensed education and skill improvement conducted with American, Turkish and Taiwanese female elementary education pre-service teachers, transformational geometry visualization exercises resulted in Turkish and Taiwanese pre-service teachers improving their spatial visualization (Smith et al., 2009). Similar experimental studies can be done for investigating the effect of instruction of different subjects to different departments such as geometry condensed instruction to Department of Chemistry and Department of Computer Education Instructional Technology departments.

However, the differences observed in the tendencies of first-year students indicate that students had already developed different tendencies that might be appropriate for their fields at the beginning of their university education. Identifying the tendencies of students at earlier ages will provide the opportunity to direct students toward educational opportunities that are in line with their tendencies.

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