The Spanish Journal of Psychology
2006, Vol. 9, No. 2, 312-320

ISSN 1138-7416

Influence of the Instructions on the Performance and Establishment of Memorization Strategies in Space Judgments

Alessandra Ackel Rodrigues and Susi Lippi Marques
Universidade Federal de São Carlos, Sao Pãulo, Brazil.

Studies of visual space perception have been assuming that people have an internal representation of the physical space that surrounds them. A variety of psychophysical procedures has been used in an attempt to measure the properties of visual space. The goal of the present study was to evaluate the accuracy of the mental representation and the strategies adopted to acquire and retain visuo-spatial information of a configuration as a function of two types of instructions. Thirty-eight undergraduate and graduate students participated in the study and were distributed in perceptive and mnemonic experimental conditions. The effect of the instructions (intentional and incidental) on the representation of the distances among the objects of the scene was estimated using exponents of power function, based on the reproduction of the distances among the stimuli of the scene. The results revealed that judgments made under intentional instructions were more frequently based on strategies related to the location of the stimuli, whereas judgments originating from incidental instructions were based on strategies related to the name of the stimuli. It was observed that the intentional instruction facilitated a more accurate mental representation of the observed experimental configuration, enhancing participants' performance.
Keywords: instructions, strategies, visuo-spatial perception, mental representation, spatial configuration

Los estudios sobre la percepción visual del espacio asumen que las personas tienen una representación interna del espacio físico que les rodea. Con la finalidad de medir las propiedades de tal percepción visual se han empleado distintos procedimientos psicofísicos. El propósito de este trabajo fue el de evaluar la precisión de la representación mental y de las estrategias adoptadas para adquirir y retener la información del espacio visible en función de dos tipos de instrucciones. Treinta y ocho estudiantes universitarios y licenciados participaron en el estudio, distribuyéndose en las condiciones experimentales perceptiva y mnemónica. Se estimó el efecto de las instrucciones (intencionales e incidentales) sobre la representación de las distancias entre los objetos del escenario empleando los exponentes de la función potencial, basado en la reproducción de las distancias entre los estímulos del escenario. Los resultados mostraron que los juicios realizados bajo instrucciones intencionales se basaban con mayor frecuencia en estrategias relacionadas con la ubicación de los estímulos, mientras que los juicios bajo instrucciones incidentales se basaban en estrategias relacionadas con el nombre de los estímulos. Se observó que las instrucciones intencionales facilitaron una representación mental más precisa de la configuración experimental observada, mejorando la ejecución de los participantes.
Palabras clave: instrucciones, estrategias, percepción viso-espacial, representación mental, configuración espacial

Correspondence concerning this article should be addressed to Marques, Susi Lippi, UFSCar, CECH-Departamento de Psicologia, Caixa Postal 676, Sao Carlos, SP, Brazil, 13565-905, susilmo@power.ufscar.br

It is usually said that individuals can generate an image of a certain scene or object even if it is not present in their environment. People often refer to this as if they had "seen it in their minds." The visual perception of space has been the focus of studies for several decades (Foley, Ribeiro-Filho, & Da Silva, 2004; Hershenson, 1998; Light & Zelinski, 1983; Loomis, 2003; Pezdek, 1983; Shepard & Metzler, 1971) as, in many tasks, individuals need information to produce an appropriate sequence of actions in the environment.

For example, when people must decide what direction they should take to go from one place to another, they often trust their memory to locate objects/locations in an environment. A great deal of research has been carried out in order to achieve a better understanding of these visual representations, usually referred to as mental images (Diwadkar & McNamara, 1997; Koriat, Goldsmith, & Pansky, 2000; Simons & Wang, 1998; Wang & Simons, 1999). Similarly, other studies have been performed in an attempt to elucidate the mechanisms and information processing in perceptive and mnemonic systems (Baddeley, 1992; Loftus, 1975; Loftus & Palmer, 1974; Palmer, 1999).

According to Clayton and Chattin (1989), spatial knowledge is accessed when maps are drawn, location direction is given, and, in general, when judgments on locations and relative distances between locations in the environment are made. Olson and Bialystok (1983) stated that the spatial properties of a stimulus can be used to recognize objects (by their form) and to remember space locations (by their position or reference points), among other judgments. However, questions concerning the way the information is coded and used for those purposes still remain unanswered.

The studies about space perception show that there is a discrepancy between the representation of the environment and the real environment (Galera & Marques, 2004; Izquierdo, 2004) and that the accuracy of memory can be affected by the introduction of verbal information (Loftus, 1975; Loftus & Palmer, 1974). As Loftus and Palmer presented in the results of their study, when participants' memories were tested regarding a videotape of automobile accidents, the substitution of just one term in one question of a questionnaire ("hit" for "smash") made the participants attribute different speeds to the automobile, which brings to mind a question about the available or requested verbal information.

The verbal information provided to the participants in the research of Light and Zelinski (1983) was related to the instructional condition. In this study, they evaluated the effect of the instruction type in two kinds of population: young and senior adults. The participants were instructed incidentally (in general terms and without information about what they should observe in the scene) and intentionally (with specific indications of what should be observed). The results showed that, for both groups, there was an interaction between performance and the instruction type to which they were exposed. The performance of the participants who performed a set of experiments under intentional instructions was superior to that of participants from the incidental instruction group.

The instructional condition is extremely important for perceptive and mnemonic processes, as it is directly related to attention; in other words, to the way an individual selects the various categories of information (Helene & Xavier, 2003). It has been observed, then, that, at the moment of visual perception of space/configuration, as well as when accessing this stored information (mental representation), verbal information permeates the process.

Models and postulates attempt to explain the distortion of these processes. According to Hintzman (2000), mnemonic processes can occur in two ways: (a) automatic decoding, which, therefore, would not be affected by selective attention, instructions, development, and training; and (b) decoding that depends on conscience, which would be affected by the above-mentioned factors.

Other studies, such as that of (Alba & Hasher, 1983; Galera & Marques, 2004), show that memory is affected by three main types of omission: selection, interpretation and integration. For Roediger and McDermott (2000), six possible factors could cause distortions: (a) the degree of relationship between the recalled stimulus and the other stimuli, present or absent, (b) events that precede or follow the stimulation situation, (c) recall of the noticed scene, (d) imagination of the memorized scene, (e) social context (effect of the conformity, for instance, as proposed by Asch, 1956), and (f) individual characteristics.

Overall, the present work was motivated by our interest in comparing space knowledge with verbal information provided to participants. In the proposed experiment, space knowledge was examined with undergraduates who made judgments about a space configuration. More specifically, estimated psychophysical functions were used to compare the participants' performance under two experimental conditions—perceptive and mnemonic versus intentional and incidental instructions—and memorization strategies used for the judgment of the space configuration.

Method

Participants

Thirty-eight voluntary students (19 female and 19 male) of different undergraduate and graduate courses at UFSCar participated in the set of experiments. They had normal or corrected vision and their ages varied from 18 to 35 years. None of them were familiar with the purpose of the experiment.

Materials

Two tables measuring $1.20 \times 1.20 \times 0.84$ m each were covered with a red and white plaid tablecloth to prevent metric-related cognitive factors from influencing at the moment the participants studied the presented configuration. On one of the tables, a space configuration composed of seven wooden cylinders (see Figure 1) was presented. Each stimulus had a different name, made of a sequence of three letters that had no known meaning in Portuguese (TUK, MAD, PID, DOT, LAF, XEM, GOB). There were two sets of each stimulus. One set was laid on the model scene and the other duplicate set (seven stimuli) was available to the participants, on a tray that was placed on a table in a room next to the room of the scene study, at the moment of task performance.

A chinrest was fixed 0.26 m from the table and 0.20 m above it, to guarantee that all participants would observe the scene from the same point. In addition, the following materials were used: a drawing board, a protocol to register the data, pencil, an eraser, a ruler, a chronometer, and two chairs.

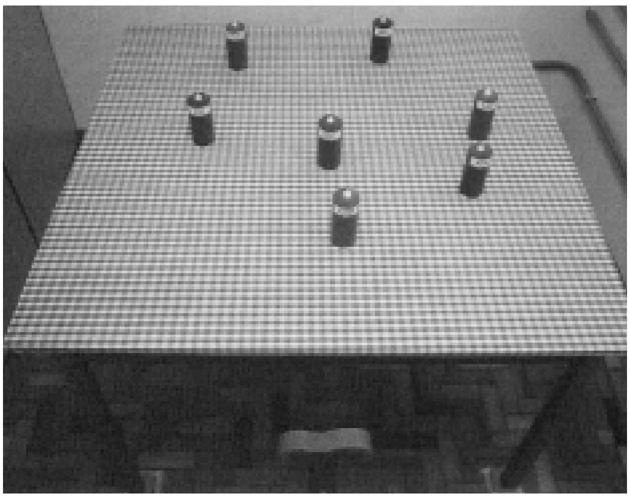
Procedure

Part A

First, the participants were divided into two experimental groups, each related to the different conditions: perceptive and mnemonic. Half of the subjects from each condition received a specific type of instruction (incidental or intentional) before they began the study of the space configuration.

In the incidental instruction, they were requested to observe the configuration presented and in the intentional instruction, they were requested, in addition to observing the configuration, to look at the distances between the stimuli that made up the configuration. In both situations, the students were allowed to observe the experimental configuration for as long as they judged necessary.

Afterwards, the participants were requested to reproduce the configuration observed in a room next door, arranging the stimuli on an identical table. The participants from the perceptive group performed this task immediately after the study and they could observe the original configuration, so that they could verify whether their arrangements were similar to the original one and make adjustments, if necessary. After observing the stimuli, the students from the mnemonic group were sent to the other room, where they waited for 7 minutes before reproducing the configuration. This time interval has been suggested by the literature (Kerst & Howard, 1978; Moyer, Bradley, Sorensen, Whiting, & Mansfield, 1978; Algom, Wolf, & Bergman, 1985; Da Silva, Marques, & Ruiz, 1987; Kemp, 1988; Algom & Cain, 1991; Algom, 1992) as sufficient and appropriate for the study of long-term memory, and it has been used in many studies (Marques, Eik, & Galera, 2000; Marques, Galera, & Cordioli, 2000; Marques, Galera, & Eik, 2002; Marques & Galera, 2002).. After that time, the participants performed the same magnitude production task as the perceptive group; however, they were not allowed to observe the experimental condition previously studied.



(a) (b)

Figure 1. Top view photograph (a) and identification (b) of the distribution of the stimuli of the experimental configuration.

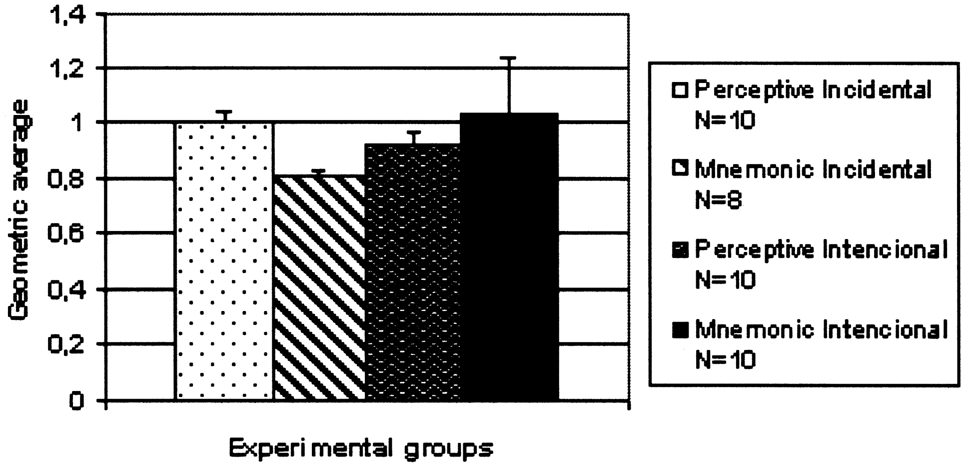


Figure 2. Geometric average and deviation-pattern of the different experimental groups' exponents.

Part B

After finishing the reproduction of the observed configuration, participants were asked about the type of strategies that they had used to study the presented configuration.

Results

Part A

Twelve exocentric distances of the stimuli that made up the configuration were previously selected to establish relatively constant amplitudes between the smallest and largest selected distance, taking into account all the possible distances among the seven stimuli in the scene. As the amplitude factor of the stimulus may affect the value of the exponent of the power function and the scale stability, care was taken when designing the experiment (Bolanowski & Gescheider, 1991; Da Silva, 1985; Da Silva & Macedo, 1982; Krueger, 1989; Stevens & Guirao, 1963). The estimated magnitude of the distances among the stimuli of the configuration produced by the participants was used to estimate the exponents of the power function (Stevens, 1975). This procedure allows the analysis of the accuracy of the participants' reproduction of the configuration.

From the analysis of the determination coefficient (r^2) found for the different experimental groups, it can be stated that the power function described the obtained results adequately, as the r^2 amplitude varied from .70 to .88.

The average exponents (n) obtained for the four experimental groups by means of the power function can be observed in Figure 2. The data suggest overestimation of the perceived distance in the intentional mnemonic condition, whereas the same group, in the incidental situation, presented underestimated judgments in relation to the unit (n = 1, 0).

A two-factor (Groups × Instructions) ANOVA was performed, which showed that the exponents (n) varied at the usually agreed limit of significance (p = .05) as a function of the type of instruction, $F(1, 34) = 4.05$, $p = .052$, and revealing an interaction between experimental group and instructions, $F(1, 34) = 17.790$, $p = .0002$.

As the effect of interaction was highly significant ($p < .001$), we decided to continue the analysis of this interaction, disregarding the analysis of the main effects (where p = .052). The existence of a significant interaction suggests that the factors should be analyzed in conjunction (the result of one factor is associated with the level of the other factor).

Thus, a post-hoc comparison of pairs (Newmann-Keuls, $p < .05$) confirmed that the average exponent obtained in the magnitude production in the mnemonic group with incidental instruction was smaller than the exponents obtained for the incidental perceptive group (p = .002), for the perceptive intentional group (p = .037), and for the mnemonic group with intentional instruction (p = .0007). These data can be observed in Figure 3.

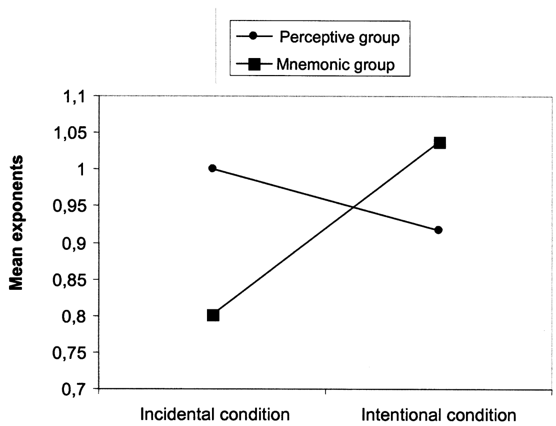


Figure 3. Comparison of the mean exponents of the experimental groups: perceptive and mnemonic; and types of instruction: incidental or intentional.

Table 1
Proportion of Participants' Successful Reproductions of the Configuration of Stimulus Name and Location as a Function of Experimental and Instructional Group

Instructions / Group		Proportion of successful reproductions		
		Stimulus	Location	Location + stimulus name
	Perceptive			
Instructions	Incidental	1.00	1.00	1.00
	Intentional	0.97	0.98	0.97
	Group Mean	0.98	0.99	0.98
	Mnemonic			
Instructions	Incidental	0.77	0.97	0.77
	Intentional	0.91	1.00	0.91
	Group Mean	0.84	0.98	0.84

A qualitative analysis of the reproduced configuration was performed regarding the location of the stimuli and their denomination, as the presented stimuli were not familiar to the participants and their names were formed by meaningless words. As the wooden stimuli were homogeneous, participants could just pay attention to their location and reproduce the scene despite the names of the stimuli.

To obtain the data for this analysis, it was established that when the stimuli were correctly identified in relation to their location and name, the response would be considered successful. However, when the location was judged correctly, but the response did not match all the requirements (name + location), it was considered an error. Thus, the data were compiled and analyzed quantitatively and are presented in Table 1.

It can be observed that, in the reproduction of the configuration, the highest amount of errors in the location of the stimuli is observed in the mnemonic groups, especially when participants were instructed incidentally. Moreover, Table 2 indicates that errors in the reproduction tended to be concentrated in the observer's most distant stimuli. The closer stimuli had an advantage in correct positioning, as well as in correct identification. Minor errors can be observed for the perceptive groups. Although the participants were aware of the fact that they could check the model scene, some of them did not make use of this possibility, thinking that they would be contributing better to the experiment if they did not.

Part B

A second type of analysis performed in this study concerns the type of strategy used by each participant to memorize the model scene. The strategies reported by the participants were categorized and their frequency was obtained. There were 80 indications of strategies found: 46 of them were obtained from the intentional instruction group and the other 34 for the incidental group. The data were analyzed, classified, and organized according to the instruction type (incidental and intentional) given. It is important to take into account that the participants could give more than one answer when asked about their strategies. The predominance of two large categories of strategies was revealed, namely, the word used to name the stimulus and stimulus location, as shown in Table 3.

Strategies used to memorize the distances between stimuli were examined in the two types of instruction conditions. Judgments made under intentional instructions depended more frequently on strategies related to the location of the stimulus, whereas the judgments made under the incidental instruction condition were based on strategies related to the name of the stimulus. Tables 4 and 5 summarize the data.

Table 3
General Percentile Distribution of Participants' Strategies as a Function of the Two Large Categories Identified and of the Type of Instruction Given

Type of instruction	Category	
	Name	Location
Incidental	61.74	41.46
Intentional	43.42	58.6

Table 2
Number of Errors (Location and Name) in the Task for Presented Stimulus

Stimulus	TUK	MAD	PID	LAF	XEM	DOT	GOB
Changes	5	4	4	3	2	4	2
Percentage	20	16	16	12	8	16	8

Table 4

Frequencies of Categories of Configuration Memorization Strategies Obtained from Participants' Responses in the Perceptive and Mnemonic Groups under Incidental Instruction (N = 34 Responses)

Strategy category	Participant	Frequency	Percentage
Associate stimulus name to something familiar	P17, P27, P36, P37, P38, P39	6	17.64
Memorize stimulus name	P1, P16, P18	3	8.82
Observe stimuli in alphabetical order	P3	1	2.94
Look at the letters in the stimulus name	P20, P26, P30, P40	4	11.76
Look the stimuli name to obtain their order	P4, P5, P17, P18	4	11.76
Observe the sequence of the names	P27, P28	3	8.82
Observe geometric relationships (straight line, curves, or illustrations)	P2, P3, P28, P40	4	11.76
Adopt a stimulus as central mark and obtain the location of the rest	P2	1	2.94
Memorize the locations	P1	1	2.94
Observe plans (background-foreground)	P5	1	2.94
Observe plans (from the lateral ones to the middle ones)	P29	1	2.94
Observe plans (from left to right)	P39	1	2.94
Observe spatial relationships (distances)	P29	1	2.94
Observe the squares of the tablecloth	P30	1	2.94
Imagine spans of distance between stimuli	P27	1	2.94
Fix the closest stimulus and its distance	P26, P40	2	5.88

Table 5

Frequencies of Categories of Configuration Memorization Strategies Obtained from Participants' Responses in the Perceptive and Mnemonic Groups under Intentional Instruction (N = 46 Answers)

Strategy category	Participant	Frequency	Percentage
Associate the stimulus name with something familiar	P7, P11, P12, P15, P21, P31, P32, P33, P35	9	19.56
Memorize the stimulus name	P8, P14, P23, P25	4	8.69
Observe stimuli in alphabetical order	P24	1	2.17
Look at the letters in the stimulus name	P10, P15, P34	3	6.52
Look at the stimulus names to obtain their order	P35	1	2.17
Observe the sequence of the names	P6, P22	2	4.34
Observe geometric relationships (straight line, curves, or illustrations)	P21, P22, P24, P25, P31	5	10.86
Adopt a stimulus as a central mark and to obtain the location of the rest	P8, P10, P23	3	6.52
Locating stimuli for order and alignment	P8, P13	2	4.34
Observe plans (foreground - background)	P6	1	2.17
Observe plans (bottom-top)	P14, P34	2	4.34
Observe stimuli in relation to the borders	P9, P33	2	4.34
Observe spatial relationships (distances)	P15, P21	2	4.34
Contain stimuli	P33	1	2.17
Observe squares of the tablecloth	P13	1	2.17
Imagine spans of distance among stimuli	P13, P23, P32	3	6.52
Fix the closest and most distant stimuli	P7, P31	2	4.34
Fix each stimulus	P32	1	2.17
Look for the whole	P34	1	2.17

Discussion

Representations of memory reflect the processing activities that take place during acquisition (Koler & Rodiger, 1984). The activation of these representations, together with the information supplied in the test (i.e., the instructions), result in a mental experience that can vary from general associations of familiarity to the effort to remember specific factors such as perceptive details (color, forms), space, and temporal information, semantic information, emotional reactions, and the cognitive processes involved.

Given the same study condition, the participant's success in the acquisition and retention of the information can vary depending on the test conditions. The data found in the present study point to a significant effect of the instructional condition in the participants' performance, related to the power function exponent obtained for the different experimental conditions. Intentional instructions favored a better performance, independently of the experimental group. This result is interesting, as it revealed a decrease of the exponent for the mnemonic group when they were instructed incidentally and an overestimation of the exponent under intentional instructions, which confirms the findings of Van Asselen, Fritschy, and Postma (2006) regarding the influence of instructional conditions on performance**.** These data also corroborate those found by Light and Zelinski (1983) in a population of young and senior adults, pointing to superior performance when participants are instructed intentionally.

It is interesting to note that the insertion of certain words in the intentional instructions favored the participants' performance. In that sense, Tversky (2000) pointed to the importance of language in the acquisition of people's knowledge about space. According to this author, good descriptions of space can favor the elaboration of perfect representations. Our data emphasize, once again, the findings of that study, suggesting that an appropriate description of the task to be performed, in this case, in the intentional instructions group, resulted in a more accurate mental representation of the experimental configuration observed by the participants. It can be inferred, then, that incidental instructions would impose greater discrimination and strategic difficulty on the participant, as the task to be performed subsequently was not clear.

Accurate performance requires the discriminative characteristics of the stimuli to be well represented in memory. Discrimination tasks such as color, location, voices, semantics, etc., have been used to access qualitative characteristics of memory. Some factors reduce the effectiveness of the judgment process, increasing the probability of errors. This effect is associated with factors that reduce the specificity or diagnosis of the sources of available information, for instance, the increase of semantic similarity (Lindsay, Johnson, & Kwon, 1991).

Likewise, Roediger and McDermott (2000) pointed out the existence of six possible factors that could be associated with distortions in memorized judgments. Based on the data presented in this study, it was possible to observe, for instance, that the relation (semantic) of a presented stimulus with other stimuli present in the experimental configuration interfered with participants' performance (i.e., the proportion of correct responses for stimuli locations and names). Tversky (2000) also stated that distance judgments that are made considering other stimuli as reference points may be associated with distortions in the direction or the estimated distance between such stimuli.

The stimulus DOT presented a larger percentage of changes than other foreground stimuli. This may be related to its semantic proximity to the stimulus GOB. Tversky (2000) stated that, when people examine the environment and build mental images of it, they display the elements according to their proximity and similarity. Thus, they remember such elements as being closer and more related to each other than they really are. The results of the study of Galera and Fuhs (2003) confirmed these ideas, as they demonstrated that, when the stimuli of an experimental situation have a high level of similarity among them, they generate a deleterious effect on the memories of both of them. Therefore, the similarity factor leads participants to focus less on the diagnostic characteristics of memory and it also increases the source of attribution errors (Marsh & Hicks, 1998).

Concerning the effectiveness in the correct positioning of the stimuli, it was observed that mistakes in the reproduction of the location tended to be concentrated on the stimulus most distant to the observer. This is in agreement with the data of the generalization proposed by Hershenson (1998) concerning the perception of visual space, where he stated that the nearer stimuli are more important than the ones that are further off.

Another way to measure mental representations is by means of the analysis of the establishment and use of strategies for the acquisition and retention of visual-spatial information (i.e., the spatial configuration studied). The data revealed a predominance of strategies as a function of two large categories: the category of the words used to name the stimuli and the category of their location. In the intentional instruction group, the emergence of the strategies observed was related to memorizing the distances between the stimuli. As mentioned above, judgments made under intentional instructions used more strategies related to stimulus location, and judgments under incidental instructions used more strategies related to stimulus name.

It is important to note that, independently of the type of instruction used, participants revealed their need to associate the name of the stimuli (without meaning to) to something familiar. Subsequently, in order to facilitate the mental manipulation of the verbal material, a symbolic code was used as a strategy to enhance the perception process and visual acquisition of the scene. In this case, the scene might have been coded as a function of the different aspects that relate to the participants' perceptual experience. In this sense, it might have been coded along a varied range of dimensions. In agreement with Brown and Craik (2000), several factors may be important in this coding process. Some of these are internal, such as: motivation, strategies, and the relevance of prior knowledge, and others are external, such as the material to be studied and the instructions.

Considering the above discussion and the data of this study, it can be concluded that reference to verbal attributes of stimuli also involves their familiarity, as some other studies (Galera & Fuhs, 2003; Postma & Haan, 1996; Wagar & Dixon, 2005) have shown that memory can establish representations of stimuli according to the observer's previous experience. In addition, the instructional condition is extremely relevant for the perceptive and mnemonic processes of visual space. All these aspects reflect the need to monitor the errors and failures that occur in information processing. More research on this topic should be carried out to identify and to clarify similarities and differences, as well as factors that interfere with perception processes and the mental representation of visuo-spatial information.

The intention of this study was to offer a methodological contribution to the investigation of the nature of the representation of visual scenes, sharing some evidence based on the effect of instructions and the strategies used during the process of acquisition and retention of visuo-spatial information.

References

Alba, J.W., & Hasher, L. (1983). Is memory schematic? *Psychological Bulletin*, *93*, 203-231.

Algom, D. (1992). Memory psychophysics: An examination of its perceptual and cognitive prospects. In: D. Algom (Ed.), *Psychophysical approaches to cognition* (pp. 441-513). Amsterdam: Elsevier.

Algom, D., & Cain, W. S. (1991). Remembered odors and mental mixtures: Tapping reservoirs of olfactory knowledge. *Journal of Experimental Psychology: Human Perception and Performance*, *17*, 1104-1119.

Algom, D., Wolf, Y., & Bergman, B. (1985). Integration of stimulus dimensions in perception on memory: Composition rules and psychophysical relations. *Journal of Experimental Psychology: General*, *114*, 451-471.

Asch, S.E. (1956). Studies in independence and conformity: A minority of one against a unanimous majority. *Psychological Monographs*, *70*, (whole nr. 416).

Baddeley, A. (1992). Working memory. *Science*, *255*, 556-559.

Bolanowski, S.J., & Gescheider, G.A. (1991). *Ratio scaling of psychological magnitude: A tribute to the memory of S. S. Stevens.* Hillsdale, NJ: Erlbaum.

Clayton, K., & Chattin, D. (1989). Spatial and semantic priming effects in tests of spatial knowledge. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *15*, 495-506.

Da Silva, J.A. (1985). Scales for perceived egocentric distance in large open field: Comparisons of three psychophysical methods. *American Journal of Psychology, 98*, 119-146.

Da Silva, J.A., & Macedo, L. (1982). A função-potência na percepção – significado e procedimento do cálculo do expoente. *Arquivos Brasileiros de Psicologia, 34*, 27-43.

Da Silva, J.A., Marques, S.L., & Ruiz, E.M. (1987). Subjective differences in exponents of psychophysical power functions for inferred, remembered, and perceived area. *Bulletin of the Psychonomic Society, 25*, 191-194.

Diwadkar, V.A., & McNamara, T.P. (1997). Viewpoint dependence in scene recognition. *Psychological Science*, *8*, 302-306.

Foley, J.M., Ribeiro-Filho, N.P., & Da Silva, J.A. (2004). Visual perception of extent and the geometry of visual space. *Vision Resarch*, *44*, 147-156.

Galera, C., & Fuhs, C.C.L. (2003). Memória visuo-espacial a curto prazo: os efeitos da supressão articulatória e de uma tarefa aritmética. *Psicologia Reflexão e Crítica, 16*, 337-348.

Galera, C., & Marques, S.L. (2004). Quantidade e qualidade: duas abordagens da memória visuo-espacial, *Revista Paidéia, 14*, 17-24.

Helene, A.F., & Xavier, G.F. (2003). Construção da atenção a partir da memória. *Revista Brasileira de Psiquiatria, 25*(Suppl. II), 12-20.

Hershenson, M. (1998). *Visual space perception: A primer*. Cambrige, MA: MIT Press.

Hintzman, D.L. (2000). Memory judgments. In E. Tulving & F.I.M. Craik (Orgs.), *The Oxford handbook of memory* (pp.149-162). New York: Oxford University Press.

Izquierdo, I. (2004). *A arte de esquecer: Cérebro, memória e esquecimento*. Rio de Janeiro: Vieira e Lent.

Kemp, S. (1988). Memorial psychophysics for visual area: Effect of retention interval. *Memory and Cognition*, *6*, 431-436.

Kerst, S.M., & Howard, J.H. (1978). Memory psychophysics for visual area and length. *Memory and Cognition*, *6*, 237-335.

Koler, P.A., & Rodiger, H.L. (1984). Procedures of mind. *Journal of Verbal Learning and Verbal Behavior, 23*, 425-449.

Koriat, A., Goldsmith, M., & Pansky, A. (2000). Toward a psychology of memory accuracy. *Annual review of psychology*, *51*, 481-537.

Krueger, L. (1989). Reconciling Fechner and Stevens: Toward a unified psychophysical law. *Behavioral and Brain Sciences*, *12*, 251-320.

Light, L.L., & Zelinski, E.M. (1983). Memory for spatial information in young and old adults. *Developmental Psychology*, *19*, 901-906.

Lindsay, D.S., Johnson, M.K., & Kwon, P. (1991). Developmental changes in memory source monitoring. *Journal of Experimental Child Psychology, 52*, 297-318.

Loftus, E.F. (1975). Leading questions and the eyewitness report. *Cognitive Psychology*, *7*, 560-572.

Loftus, E.F., & Palmer, J.C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behavior*, *13*, 585-589.

Loomis, J.M. (2003). Visual space perception: Phenomenology and function. *Arquivos Brasileiros de Oftalmologia, 66*, 26-29.

Marques, S.L., Eik, G., &. Galera, C.A. (2000). Spatial perception: Perceptive and mnemonic estimations with different psychophysical procedures. *International Journal of Psychology, 35*, 143-143.

Marques, S.L., & Galera, C.A. (2002). The effect of arithmetic and visuo-spatial tasks on memory for items and their spatial locations. Presented at the 18th Annual Meeting of the International Society for Psychophysics - Fechner Day. Rio de Janeiro: *Annual Meeting of International Society for Psychophysics, 18,* 464-469.

Marques, S.L., Galera, C.A., & Cordioli, R. (2000). Interferência produzida por tarefas verbais e visuo - espaciais em estimativas perceptivas e mnemônicas. In XXX Reunião Anual da Sociedade Brasileira de Psicologia, Brasília. *Livro de Resumos da XXX Reunião Anual da Sociedade Brasileira de Psicologia,* 229.

Marques, S. L., Galera, C., & Eik, G. (2002). Efeito de tarefas intervenientes verbais e visuo-espaciais sobre estimativas mnemônicas em diferentes procedimentos psicofísicos. *Arquivos Brasileiros de Psicologia, 52,* 26-34.

Marsh, R.L., & Hicks, J.L.(1998). Test formats change source-monitoring decision processes. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 24,* 1137-1151.

Moyer, R.S., Bradley, D.R., Sorensen, M.H., Whiting, J.C., & Mansfield, D. (1978). Psychophysical functions for perceived and remembered size. *Science, 200,* 330-332.

Olson, D.R., & Bialystok, E. (1983). *Spatial cognition: The structure and development of mental representations of spatial relations.* Hillsdale, NJ: Erlbaum.

Palmer, S.P. (1999).*Vision science: Photons to phenomenology*. Cambrige, MA: MIT Press.

Pezdek, K. (1983). Memory for items and their spatial locations by young and elderly adults. *Developmental Psychology, 19,* 895-900.

Postma, A., & Haan, H.F.D. (1996). What was where? Memory for object location. *Quarterly Journal of Experimental Psychology, 49A*, 178-199.

Roediger, H.L., & McDermott, K.B. (2000). Distortions of memory. In E. Tulving & F.I.M. Craik (Orgs.), *The Oxford handbook of memory* (pp. 149-162). New York: Oxford University Press.

Shepard, R. N., & Metzler, J. (1971). Mental rotation of three-dimensional objects. *Science, 171*, 701-703.

Simons, D.J., & Wang, R.F. (1998). Perceiving real-world viewpoint changes. *Psychological Science, 9*, 315-320.

Stevens, S.S. (1975). *Psychophysics: Introduction to its perceptual, neural and social prospects.* New York: Wiley.

Stevens, S.S., & Guirao, M. (1963). Subjective scaling of length and area and the matching of length to loudness and brightness. *Journal of Experimental Psychology, 66*, 177-186.

Tversky, B. (2000). Remembering spaces. In E. Tulving & F.I.M. Craik (Eds.), *The Oxford handbook of memory* (pp. 363-378). New York: Oxford University Press.

Van Asselen, M., Fritschy, E., & Postma, A. (2006). The influence of intentional and incidental learning on acquiring spatial knowledge during navigation. *Psychological Research, 70*, 151-156.

Wagar, B.M.. & Dixon, M.J. (2005). Past experience influences object representation in working memory. *Brain and Cognition, 57*, 248-256.

Wang, R.F., & Simons, D.J. (1999). Active and passive scene recognition across views. *Cognition, 70*, 191-210.

Received December 15, 2006
Review received August 22, 2006
Accepted August 23, 2006