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DOES THE WAY WE MEMORIZE INFORMATION DEPEND ON THE WAY WE ARE GOING TO USE IT?

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Abstract

Existing research has shown modality-specific differences in short-term memory performance. Almost all previous studies have manipulated the input information without considering the way it will be used at output. In the current study, participants memorized spatially ordered arrays of letter-like shapes simultaneously shown on a screen, and recalled the stimuli by (i) drawing them on a sheet of paper, (ii) typing them on a keyboard according to a specified item-to-key map, and (iii) pronouncing them aloud using an item-to-letter map suggested by the letter-like items' appearance. It was assumed that manipulating the output modality using the fixed stimuli set would lead to favoring different encoding strategies and subsequently result in different error patterns. Although visual input seems to be the main determinant of overall error rates in the drawing, typing and pronouncing tasks, less prominent but robust output-related differences between these tasks were also found. The pen and paper copying task showed a significant excess of substitutions called "upside down errors" and incorrect order responses. The typing task showed a significant excess of omissions. The pronouncing task showed a significant excess of mirror errors and the lowest rate of 90-degree rotations. The differences among patterns of errors in the different tasks are consistent with the hypothesized impact of the output modality on the way that visual information is stored in working memory.

Keywords: working memory, recall, output modality, coding strategy.

Introduction

People hold different lists of items in working memory (WM) and recall the retained information through "output modalities" (MacKay, 1993) like speaking, writing and typing. Numerous studies have examined the relationship between the modality of information at input and the format of representation in WM (Margrain, 1967; Penney, 1989; Baddeley, 1992; Quinn & McConnell, 1996; Mayer & Moreno, 1998; Zimmer & Speiser, 2002; Zimmer, Speiser, & Seidler, 2003; Brünken, Plass, & Leutner, 2004; Avons & Sestieri, 2005; Brown, Forbes, & McConnell, 2006; Kosslyn, Ganis, & Thompson, 2006; Logie & van der Meulen, 2009; Keogh & Pearson, 2011). Depending on its input modality, information may be stored in at least two distinct ways: the visuo-spatial sketchpad and the phonological loop (Baddeley & Hitch, 1974). It has been shown (for a review, see Logie, 1995; Burgess & Hitch, 2005) that, besides its input modality, the representation retained in WM depends on other input factors such as the presence of inter-item associations (e.g., Arieh & Algom, 2002), degree of familiarity (e.g., Diana & Reder, 2006) and stimuli similarity (e.g., Poirer, Saint-Aubin, Musselwhite, Mohanadas, & Mahammed, 2007; Saito, Logie, Morita, & Law, 2008). It is also known that the format of retained information depends on the way it will be used (Tversky, 1969; Caramazza & Costa, 2000; Pylyshyn, 2003; Goolkasian, Foos, & Krusemark, 2008). However, the latter issue has been addressed far less frequently.

The present paper aims to explore the influence of the output modality used in a memory recall task onto the information encoding. Participants memorized an ordered array of letter-like shapes simultaneously shown on the screen and recalled them by (i) drawing on a sheet of paper, (ii) typing on a keyboard according to a specified item-to-key map, and (iii) pronouncing aloud using an item-to-letter map suggested by the letter-like item appearance. It was assumed that manipulating the output modality using the fixed stimuli set would result in favoring different encoding strategies and subsequently reveal different error patterns.

Method

Participants

A total of 84 healthy adults (58.3% female) with normal or corrected-to-normal vision volunteered to participate in the study. Participants were between the ages of 18 and 46 (M = 25.04, SD = 6.124). All of them gave written informed consent.

Apparatus

The experiment was controlled in a semiautomatic manner. Stimuli were shown in low resolution (600×800) on a second monitor attached to a computer. The flow of the experiment was controlled by custom software which was also used to present the visual stimuli and collect manual responses with to-the-millisecond time precision. The manual responses were recorded with an additional keyboard attached to the computer.

Materials

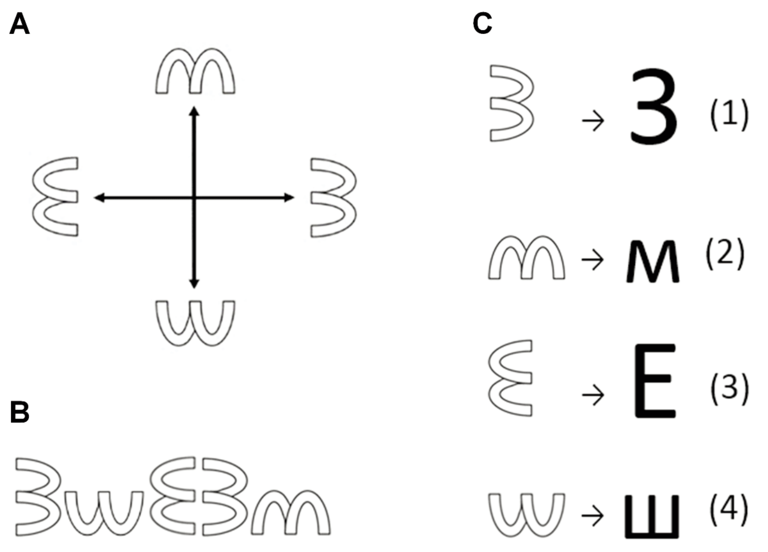
The visual stimuli were constructed from a single shape that can take four different orientations (Figure 1A). These shapes were arranged into different sequences of three, four or five elements (Figure 1B). A total of twenty sequences were prepared for each possible number of elements (span). The shapes and a fixation cross were shown in black against a white background. A warning stimulus was shown in red and imperative stimuli were colored pictures (they are shown in gray scale in Figure 2). All stimuli were presented at the center of the screen and their size did not exceed 8 angular degrees. Participants were seated at a desk with the viewing distance maintained at approximately 1.5 m.

Experimental design

A 3×3 within-subject design was used, with TASK (pen-and-paper copying, typing and pronouncing) and SPAN (3, 4 and 5 elements) as factors. A session of the experiment consisted

Figure 1

Examples of the stimuli



A. Four different stimuli produced by 90-degree rotation of the basic shape. B. An example of the sequence of five stimuli. C. The similarity-based correspondence between the stimuli and Russian block letters.

of three blocks of trials, one for each level of the task factor. Each block consisted of 60 trials: twenty of three elements (span A), twenty of four elements (span B) and twenty of five elements (span C). Thus, each participant performed a total of 180 trials during three consecutive sessions. None of the sequences were used twice within a block, and the span order varied from one participant to another and from task to task (ABC, ACB, BAC, BCA, CAB, CBA).

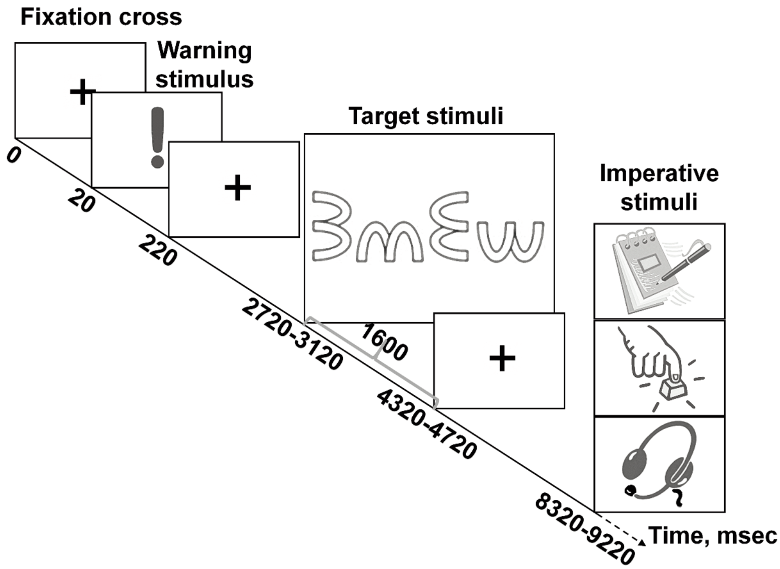
Procedure

Each trial consisted of the following events: a 20-ms fixation cross was followed by a warning stimulus lasting 200 ms, followed again by the fixation cross (2500–2900 ms) to make a participant ready for the target stimuli (Figure 2). After the presentation of target stimuli (1600 ms), a retention period (4000–4500 ms) began with the appearance of another fixation cross that switched to an imperative stimulus prompting participants to start the recall. The imperative stimulus remained on the screen until the participant responded.

Each participant completed three tasks using the same stimulus material (a block of 60 sequences). The most important precondition for all three tasks was to recall the stimuli in the original order and not before the imperative stimulus. The first task was pen

Figure 2

The sequence of events in a trial



Note. The events are shown with pictograms arranged along the time axis. The fixed and variable time intervals between the successive events and corresponding exposure times are printed beneath the time axis. The pictograms of three possible cues showing a note pad, a finger hitting a key and headphones are stacked together.

and paper copying. The instruction was to draw a single-lined copy of the target stimulus using a pen and a paper record form. The next task was typing. A participant was told to associate the stimulus elements with visually similar Russian block letters corresponding to the latin z, m, e and sh (Figure 1C) and to type the recalled stimuli on a keyboard. Letters were printed in an enlarged font on stickers that were attached to a group of nearby keys in order to minimize searching. It is important to note that while using the keyboard a participant could not monitor the letters he/she had already entered, and could not make corrections. The final task was pronouncing. The participant was again asked to associate the target stimuli with the same Russian letters (Figure 1C) and to pronounce aloud what had been memorized. Responses were recorded using a voice recorder. All tasks were administrated in a fixed order (pen and paper copying → typing → pronouncing) to minimize a potential inter-block interference in the encoding strategy choice. Pen and paper copying does not bias towards either of two strategies of stimuli encoding, phonological or pictorial. Asking a participant to recall a sequence of shapes by typing the predefined set of keys may introduce a bias towards memorizing stimuli by encoding the spatial positions of corresponding keys. Finally, the strongest bias is associated with pronouncing which strongly encourages using the phonological encoding and subvocal rehearsal as a maintenance strategy.

Data processing

There were three types of data to analyze: paper forms with hand-drawn sequences, disk data files collected during typing and voice recordings with uttered sequences. The responses recorded in all three tasks were encoded with digits (Figure 1C) and matched to the codes of actually presented sequences.

The next step was the processing of incorrect responses that did not match their key codes. Besides the total number of incorrect responses (total error rates), the number of omissions, extra responses, and the number of responses of correct length but incorrect order were computed. Those erroneous responses, which were not ascribed to an incorrect order, were checked for substitutions. The frequency of each possible substitution of one shape for another was computed for each cross condition TASK×SPAN (a total of nine). The sum of the frequencies of all possible substitutions was equal to one. A substitution (e.g., A for B) and its inverse (B for A) were considered as equal and averaged.

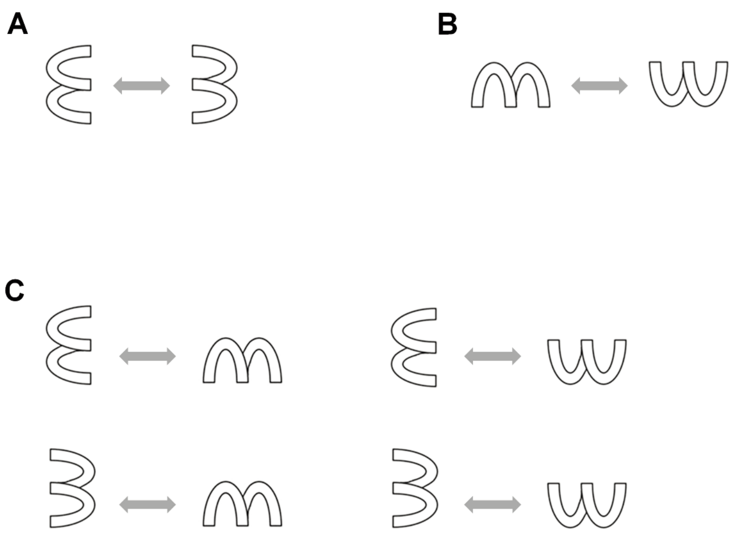
All substitutions were broken onto three classes: mirror errors (Figure 3A), upside down errors (Figure 3B) and 90-degree rotations (Figure 3C). The substitution frequencies were averaged within these classes.

Results

A 3×3 within-subject design included two factors with three levels: TASK (pen and paper copying, typing and pronouncing) and SPAN (3, 4 and 5 elements). The dependent variables

Figure 3

Types of substitution errors. A. Mirror errors. B. Upside down errors. C. 90-degree rotations



were total error rates, incorrect order responses, omissions, extra responses, mirror errors (Figure 3A), upside down errors (Figure 3B) and 90-degree rotations (Figure 3C). Descriptive statistics for all variables are shown in Table 1.

Table 1

Descriptive statistics for different measures of error rates (N = 84)

Task	Measure	3 elements				4 elements				5 elements			
		Median	IQR	Mean	SD	Median	IQR	Mean	SD	Median	IQR	Mean	SD
Copying	total error rates	1	7	1.2	1.5	1	11	2.4	2.6	5	15	5.6	3.8
	incorrect order	0	3	0.5	0.8	1	9	1.9	2.2	2	7	2.3	1.8
	omissions	0	0	0	0	0	0	0	0	0	1	0	0
	mirror errors	0	0.17	0.04	0.06	0	0.25	0.01	0.04	0.1	0.3	0.09	0.07
	upside down errors	0	0.33	0.02	0.06	0	0.25	0.03	0.05	0.03	0.26	0.05	0.05
	90-degree rotations	0	0.12	0.01	0.02	0	0.13	0	0.01	0	0.05	0.01	0.01
Typing	total error rates	1	9	1.5	1.8	1.5	12	2.3	2.4	4	18	4.9	4.0
	incorrect order	0	4	0.5	0.7	1	7	1.5	1.6	1	6	1.7	1.6
	omissions	0	5	0.5	0.9	0	9	0.7	1.2	1	12	1.3	1.8
	mirror errors	0	0.25	0.03	0.06	0	0.5	0.02	0.06	0.06	0.3	0.07	0.07
	upside down errors	0	0.17	0.02	0.05	0	0.14	0.01	0.03	0	0.25	0.03	0.05
	90-degree rotations	0	0.08	0.01	0.02	0	0.13	0.01	0.02	0	0.08	0.01	0.01
Pronouncing	total error rates	0	13	1	1.8	1	13	2.1	2.4	5	15	5.0	4.8
	incorrect order	0	7	0.5	1.0	1	13	1.9	2.3	2	8	2.0	1.6
	omissions	0	0	0	0	0	0	0	0	0	0	0	0
	mirror errors	0	0.17	0.02	0.05	0	0.25	0.01	0.04	0.1	0.3	0.11	0.09
	upside down errors	0	0.17	0.03	0.05	0	0.25	0.01	0.04	0	0.2	0.03	0.05
	90-degree rotations	0	0.04	0.01	0.01	0	0.03	0	0	0	0.03	0	0

Taking into account the fact that the distributions of analyzed variables could not be considered as normal, the median and interquartile range (IQR) were included within the table along with the mean and standard deviation (SD). In order to cope with the potential interaction of TASK and SPAN factors, a general linear model (GLM) was used, since it is known that this method is relatively insensitive to moderate departures from normality.

Table 2 shows the multivariate GLM results (F-test for Wilks' Lambda). All types of errors and total error rates significantly increased as the number of elements (SPAN) grew, except for the substitutions called 90-degree rotations. Total error rates changed insignificantly across the tasks, showing no learning effect. At the same time, the participants made different types of errors depending on the output modality (TASK).

A significant main effect of TASK was found for incorrect order responses. Pairwise comparisons showed that there were significantly more incorrect order responses in the copying task as compared to the typing task (Bonferroni corrected: $p = .042$, $F(1, 83) = 6.288$, $\eta^2_p = .070$). Omissions also depended on the output modality, showing a significant main effect of TASK. Pairwise comparisons revealed significant differences in all tested pairs: there were more omissions in typing versus copying (Bonferroni corrected: $p < .0001$, $F(1, 83) = 42.523$, $\eta^2_p = .339$) and versus pronouncing (Bonferroni corrected: $p < .0001$, $F(1, 83) = 45.525$, $\eta^2_p = .354$), and in copying versus pronouncing (Bonferroni corrected: $p = .021$, $F(1, 83) = 7.545$, $\eta^2_p = .083$). Besides the main effect of TASK, a TASK by SPAN interaction was found for this type of error. Participants made significantly more omissions when typing the

Table 2

The impact of the TASK factor (pen and paper copying, typing and pronouncing), SPAN factor and TASK by SPAN interaction on different types of errors found in 3-, 4- and 5-element sequences (N = 84). GLM results were obtained using the Wilks' Lambda criterion

	SPAN	TASK	SPAN×TASK
Total error rates	$F(2, 82) = 84.975$, $p < .0001$, $\eta^2_p = .675$	$F(2, 82) = 1.295$, $p = .279$, $\eta^2_p = .031$	$F(4, 80) = 1.366$, $p = .253$, $\eta^2_p = .064$
Incorrect order	$F(2, 82) = 73.848$, $p < .0001$, $\eta^2_p = .643$	$F(2, 82) = 3.939$, $p = .023$, $\eta^2_p = .088$	$F(4, 80) = 2.005$, $p = .102$, $\eta^2_p = .091$
Omissions	$F(2, 82) = 12.628$, $p < .0001$, $\eta^2_p = .235$	$F(2, 82) = 25.302$, $p < .0001$, $\eta^2_p = .382$	$F(3, 81) = 8.944$, $p < .0001$, $\eta^2_p = .249$
Mirror errors	$F(2, 82) = 58.992$, $p < .0001$, $\eta^2_p = .590$	$F(2, 82) = .382$, $p = .683$, $\eta^2_p = .009$	$F(4, 80) = 3.417$, $p = .012$, $\eta^2_p = .146$
Upside down errors	$F(2, 82) = 11.720$, $p < .0001$, $\eta^2_p = .222$	$F(2, 82) = 3.967$, $p = .023$, $\eta^2_p = .088$	$F(4, 80) = 1.319$, $p = .270$, $\eta^2_p = .062$
90-degree rotations	$F(2, 82) = .284$, $p = .753$, $\eta^2_p = .007$	$F(2, 82) = 13.633$, $p < .0001$, $\eta^2_p = .250$	$F(4, 80) = 1.060$, $p = .382$, $\eta^2_p = .050$

sequences of five elements than copying the sequences of the same length (Bonferroni corrected: $p < .0001$, $F(1, 83) = 37.468$, $\eta^2_p = .311$) and made no such errors copying the sequences of three and four elements and pronouncing the sequences of all spans.

Regarding the frequency of mirror errors, there was no significant main effect of TASK, however a TASK by SPAN interaction was observed. There was a significant effect of TASK only at the most difficult SPAN level (five elements). Pairwise comparisons revealed significantly more errors in the pronouncing task versus typing (Bonferroni corrected: $p = .018$, $F(1, 83) = 7.812$, $\eta^2_p = .086$).

The frequency of upside down errors also turned to be task-dependent. A significant main effect of TASK was observed. Pairwise comparisons showed significantly more errors in copying versus typing (Bonferroni corrected: $p = .036$, $F(1, 83) = 6.667$, $\eta^2_p = .074$). There was also a tendency to show more errors in copying versus pronouncing (Bonferroni corrected: $p = .054$, $F(1, 83) = 5.800$, $\eta^2_p = .065$).

A significant main effect of TASK was found for the substitutions called 90-degree rotations. Maximum error rates were observed in the typing task, with minimum error rates observed in the pronouncing task. Pairwise comparisons showed significant differences between typing and pronouncing (Bonferroni corrected: $p < .0001$, $F(1, 83) = 22.145$, $\eta^2_p = .211$) and between copying and pronouncing (Bonferroni corrected: $p = .003$, $F(1, 83) = 12.228$, $\eta^2_p = .128$).

The most pronounced differences in error rates across tasks were found for the 5-element sequences (Figure 4).

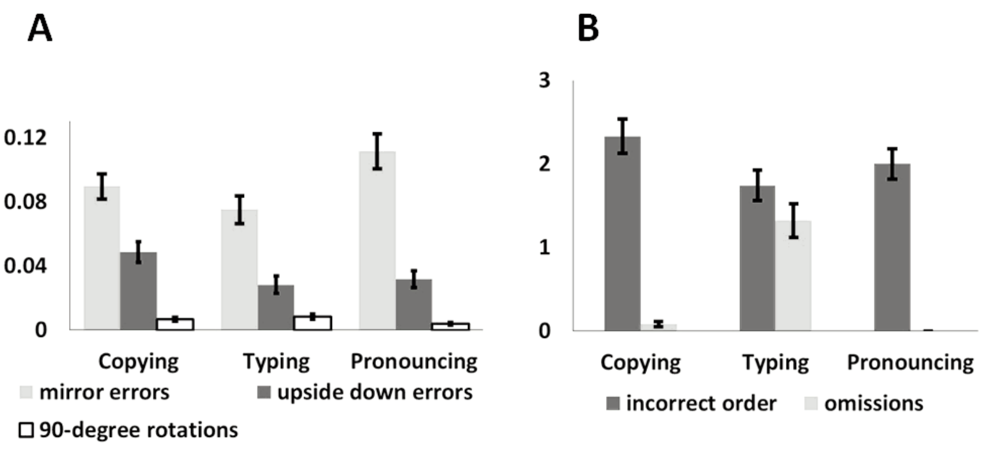
Discussion

In general, observed error rates are a result of an accumulation of errors committed along the entire way from seeing visual stimuli to producing responses; that is, during the stages of visual perception, retention and response execution. The output modality may affect the error rate during stimuli encoding because of varying code formats, and during retention because different code formats might be error-prone to a different degree, and during the response production stage. The present experiment showed that regardless of the output modality, relative frequencies of errors of different kinds follow roughly similar profiles: the rate of mirror errors is higher than the rate of upside down errors and 90-degree rotations for all three output modalities. This finding arises from the visual similarity effect (Logie, Della Sala, Wynn, & Baddeley, 2000) and is in line with the accepted fact that mirror image confusion is the most frequent among other similarity-provoked errors (for a review, see Gregory & McCloskey, 2010). Along with this, the effect of SPAN was another expected result that made the current data comparable (for a review, see Cowan, 2001).

The qualitative similarity of error profiles among the three tasks suggests that a common input is by far the biggest factor affecting recall accuracy, while the observed inter-task differences related to output modality are more subtle. Following the suggestion that different "competitive maps", such as phonemic or letter maps (Franconeri, Alvarez, & Cavanagh, 2013), underlie high-level functions, one may try to account for these across-task differences

Figure 4

Mean error rates for copying, typing and pronouncing 5-element sequences, computed for the group of 84 participants. Error bars represent standard errors



A. Mirror errors, upside down errors and 90-degree rotations (y-axis represents the frequency of substitutions).

B. Incorrect order responses and omissions (y-axis represents error rates).

by assuming that copying, typing and pronouncing preferably rely on different representation formats: an image, a grapheme and a phoneme (see Figure 5). While an image and a phoneme belong to the pure visuo-spatial and verbal domains, respectively, a grapheme may employ both visuo-spatial and phonological codes. The first column of the schema in Figure 5 contains types of errors specific to each type of representation. The plus/minus signs show hypothetical associations between the error patterns analyzed in this study and three possible representations. Below, the error profiles for each task are considered from this perspective.

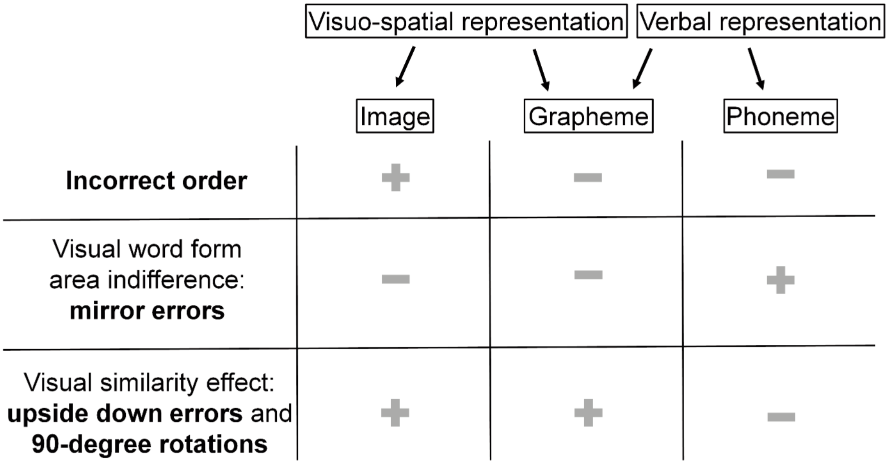
Pen and paper copying

During the first task, participants should recall stimuli and draw their single-lined copy in exactly the same spatial arrangement as they were shown. Compared to the other tasks, this task showed significantly more upside down errors. This task also showed an excess of incorrect order responses, although the significance was revealed only between copying and typing.

The relative excess of upside down errors may be due to a stronger similarity between the pictorial forms of items #2 and #4 (Figure 1A, top and bottom items) in the first task as compared with the other two tasks. By contrast, in the two other tasks the participants were asked to use Russian block letters (typing) or sounds (pronouncing), which are dissimilar in their visual appearance and phonological qualities (Figure 1C (2, 4)). It is interesting that participants might represent the shapes

Figure 5

The error specificity of three possible representations: image, grapheme and phoneme. The scheme summarizes the results of the analysis undertaken in the current study and considers being only hypothetical



with the Latin letters W and M which are visually but not acoustically similar (Best & Howard, 2005); several participants did so, according to their self-report.

The excess of incorrect order responses in the copying as compared to the other tasks seems to be unrelated to the preferable usage of pictorial or grapheme representations. Rather, this excess may arise at the response production stage. The exact temporal order in which shapes have to be drawn is not specified in the copying task. This makes copying, typing and pronouncing unequal in terms of recall. Whereas typing and pronouncing unambiguously involve serial recall, copying allows for free recall. These results are consistent with the view that "temporally defined interitem associations help to guide retrieval" (Klein, Addis, & Kahana, 2005, p. 838).

Typing

During the second task, participants should recall the shapes and sequentially match them with the proper keys on the keyboard. This task resulted in a significant excess of omissions as compared to the other tasks. The excess of omissions found in the typing task is hardly related to assumed graphemic representations of the visual stimuli. Rather, this excess might be generated at the execution stage and caused by the fact that, while typing, participants could not monitor the letters they had already entered and could not correct their responses. This explanation is supported by the observation that typists tended to detect about 30% fewer errors when they were prevented from seeing their typed copy (Long, 1976). Extra omissions could also result from inadequate force or reach on keystrokes (Salthouse, 1986; MacKay, 1993).

Pronouncing

During the third task, participants should recall stimuli and sequentially pronounce the corresponding Russian letters (Figure 1C). In comparison to the two other tasks, the pronouncing task showed a significant excess of mirror errors and the lowest rate of 90-degree rotations.

It is proposed to link the processing of mirror-paired stimuli to the visual word form area (VWFA) which distinguishes between words and their mirror images but remains mirror-invariant for pictures and faces (Dehaene et al., 2010; Dehaene & Cohen, 2011). The stimuli used in the current experiment are letter-like shapes, so their processing should involve the VWFA at input across all three tasks (Barton, Fox, Sekunova, & Iaria, 2010). In the copying and typing tasks, the VWFA may continue to process both pictorial and graphemic representations during the retention stage, while in the pronouncing task the VWFA becomes unemployed as soon as the phonological code is created, thus resulting in an increased rate of mirror errors. This line of reasoning is also supported by the fact that the lowest rate of mirror errors was found in typing, when VWFA is supposed to be the most sensitive to the mirrored graphemes.

The lowest rate of upside down errors in copying as compared to the other two tasks is explained via a greater similarity between the pairs of corresponding shapes. This argument is grounded on the assumption that these pairs of shapes are more similar if they are stored in pictorial format relative to the situation when they are stored in either graphemic or phonemic formats. Following the same logic, one should expect a similar outcome for 90-degree rotations, but that was not found: the rate of 90-degree rotations turned out to be the highest in typing, not in copying. However, the excess of 90-degree rotations found in typing could have been generated at the execution stage. Stickers with Russian block letters were attached to the keyboard in the order 1→2→3→4 (Figure 1C), thus favoring 90-degree rotation errors upon mistakenly pressing an adjacent key. The latter is known to be the most frequent error in typewriting (Salthouse, 1986; MacKay, 1993).

Conclusions

Although visual input seems to be a major determinant of the overall error rates in drawing, typing and pronouncing tasks, less prominent but robust across-task differences are also found.

The most pronounced differences in error rates across tasks were found for the highest memory load condition (5-element sequences). The pen and paper copying task showed a significant excess of the substitutions called "upside down errors" and incorrect order responses. The typing task showed a significant excess of omissions. The pronouncing task showed a significant excess of mirror errors and the lowest rate of 90-degree rotations.

It is suggested that the across-task differences in patterns of specific errors might result, in part, from the preferable use of different code formats (pictorial, graphemic, and phonological) and, in part, from unequal conditions at the response execution stage.

The results of the present experiment suggest that an output format should be considered when interpreting results of immediate recall experiments.

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Зависит ли удержание информации в рабочей памяти от способа ее воспроизведения?

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Резюме

Существующие исследования свидетельствуют в пользу наличия модально-специфических различий процессов кратковременного удержания информации в рабочей памяти. Практически во всех известных исследованиях варьировались параметры «входной», запоминаемой информации, при этом не рассматривалось возможное влияние на рабочую память той деятельности, в которой эта информация в дальнейшем использовалась. В настоящем исследовании испытуемым было предложено запомнить симультанные последовательности похожих на буквы фигур и воспроизвести их тремя способами: (1) копируя от руки на лист бумаги, (2) перекодируя в печатные буквы, ввести с помощью клавиатуры, и, (3) ассоциируя с теми же буквами, произнести вслух. Мы предположили, что разные задачи воспроизведения одного и того же набора стимулов повлияют на стратегии перекодирования информации и как следствие будут различаться паттернами ошибок. Хотя качественные характеристики предъявляемых элементов оказали наибольшее влияние на характер ошибок при копировании, вводе с помощью клавиатуры и произнесении вслух, было также обнаружено убедительное влияние способа воспроизведения информации. При копировании стимулов от руки на лист бумаги было выявлено статистически значимое преобладание вертикальных инверсий изображений и ошибок порядка. В задаче с вводом ответа при помощи клавиатуры значимо преобладали пропуски элементов. При произнесении вслух значимо возрастало количество зеркальных ошибок, при этом количество поворотов элементов на 90° значимо уменьшалось. Полученные различия свидетельствуют в пользу влияния способа воспроизведения зрительной информации на ее хранение в рабочей памяти.

Ключевые слова: рабочая память, воспроизведение информации, способ воспроизведения, стратегия перекодирования.

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COHESION, SIMILARITY AND VALUE IN PARENT-CHILD REPRESENTATIONS OF ALBANIAN AND SERBIAN IMMIGRANT AND ITALIAN NATIVE CHILDREN

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Abstract

The study of parent-child representations across cultures is important in order to obtain a proper understanding of the attributes, size and positioning of such figures as indicators of different interaction patterns across cultures. A thorough base of research evidence for the interpretation of children's drawings may facilitate work in multicultural educational settings and enhance our understanding of cultural diversity in schools. Italy provides an ideal context for the study of parent-child representations, as the country has witnessed increasing cultural diversity in recent years with the immigration of various ethnic groups. This study examined the extent to which this context influences children's representations in domains of Cohesion (interpersonal bonding), Similarity (affinity) and Value (spatial relevance) among parent-child figures because these domains inform important representational processes of interpersonal bonding with parents across specific cultures. The Pictorial Assessment of Interpersonal Relationships (PAIR) was used to codify drawings of 326 children with Albanian (n = 59), Serbian (n = 85) and Italian (n = 182) backgrounds. The results showed that in drawings made by Albanian and Serbian children parental figures were drawn similar to and close to the child figure representing their less independent reciprocal stance. The parental figures drawn by Italian children appear bigger and farther apart. Important implications may be derived from the results in facilitating work in multicultural educational settings, by enhancing knowledge regarding cultural diversity in schools.

Keywords: drawings; parent-child representations; Albanian and Serbian immigrant children, Italian children, PAIR.

This study explores parent-child representations in the drawings of Albanian and Serbian immigrant and Italian native children in Italy. Although research shows the existence of context-dependent influences in parent-child representations in terms of interpersonal bonding, and the distance between parents and children in Swedish, British or Arab cultures (Andersson & Andersson, 2009; Andersson, 1995; Golomb, 2004; Lev-Wiesel & Al-Krenawi, 2000), this research is still emerging especially with regard to the comparison of drawings of children in Italy. The study of parent-child representations across cultures is important for three reasons. Firstly, the available research consistently shows that the size, positioning and the attributes of depicted objects in children's drawings can be reliably interpreted as