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# What Can Replication Research Tell Us About the Historical Development of Mental Functions?

## P.I. Zinchenko's (1939) Case Revisited

According to the common maxim, history is not an experimental science. Yet it may be argued that the history of psychology can be an experimental enterprise. In order to test our hypothesis of the historical development of mental functions we conducted a replication of Zinchenko's classical psychological study conducted more than seventy years ago. Zinchenko's experiments were designed from a specific theoretical perspective and within a specific research framework, commonly referred today to as Soviet activity theory, which should not be confused with its contemporary variant developed by Yrjö Engeström, his associates and followers (see, e.g., Engeström, 1987). During the 1930s, the theory was still in its development stage and, historically, the influence was mutual: the nascent theory informed experimentation, and, on the other hand, Zinchenko's findings provided a vital empirical basis for the theory development. Zinchenko's original study was conducted in the mid-1930s and published in 1939 (Zinchenko, 1939, 1939/1983). The purpose of the study was to conduct an experimental investigation of involuntary memorization as a function of activity. Specifically, this study tested the hypothesis that involuntary memorization takes place most efficiently when the material to be

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remembered is involved in some meaningful activity. In order to test this hypothesis, two different types of stimulus materials were used: in two experimental series, pictures and numbers were part of some activity and both took place on the goal and the background of action. In this study Zinchenko confirmed this hypothesis and, furthermore, concluded that recall depends on the place of the material in the structure of activity. In his retrospective historical analysis of this research, A.N. Leontiev thus summarized the main contribution of this groundbreaking study: "If the object occupies the position of a goal [of an action]—you have one effect; if the object occupies the structural position of condition—you have another effect: this was the essence, the most important thing" (Leontiev, 1986). Following a recent proposal, we refer to this major outcome of Zinchenko's work as the "*activity-structure effect* (the material that constitutes the goal of action is recalled more effectively than the very same material when it relates to the conditions for achieving the goal)." Another finding of primary importance with respect to Zinchenko's study of 1939 is the discovery of the "*negative effect of age* (the superiority of first-graders over older age groups in involuntary memorization of numbers when solving arithmetic problems)" (Meshcheryakov, this issue, p. 32) that was demonstrated by the seemingly striking finding that the recall rate of the background of action material was highest in the preschoolers and gradually decreased with age, being the lowest in the adults.

Our study continues the tradition of replications of the classical Soviet studies in the psychology of "higher mental functions" initiated by Vygotsky, his students and followers. Thus, for example, the classic studies on mediated memory and attention by Leontiev (1931, 1932) were widely replicated in the works of Adams and associates (1987), Lokhov and associates (1993), van der Veer (1994), Myasoed (2003), Meshcheryakov and associates (2008), Fedorova (2008), and Fediakina (2008). However, arguably the most well-known Soviet study in the field of the psychology of memory is the classical work by Istomina (Istomina 1948a, 1948b, 1948c, 1948/1975) that was first replicated by Weissberg and Paris (1986) and Schneider and Brun (1987). These two studies posed important questions about the integrity of the original study design and the validity of its conclusions. The two replications by Istomina in the 1980s led to a series of subsequent attempts at replicating Istomina's study in the West: see Newman (1990), Schneider and Hasselhorn (1994), Oyen and Bebko (1996), and Mistry, Rogoff and Hermann (2001). This sequence of replication studies was discussed at considerable length by Folds-Bennett (1994) and Reese (1999). Typically, the motivations for these replications included "correcting perceived shortcomings in the original study, investigating the generality of previous results, and resolving inconsistencies of previous results with later results or theories" (Reese, 1999).

In our study, the method of replication takes on a different meaning, that of an experimental investigation of psychological processes in their historical development over considerable periods of time. The inspiration for this study was yet another Istomina replication study done by Ivanova and Nevoennaia who meticulously

replicated the original design of Istomina's study and discussed the differences in mnemonic processes in the 1940s in Soviet children and in the 1990s in Ukrainian children. The authors concluded that the processes of involuntary memorization accelerated in children over the period of roughly fifty years (Ivanova and Nevoennaia, 1998). However, this conclusion was somewhat undermined by the series of studies that Istomina conducted in the 1960s (Istomina, 1964, 1965a, 1965b, 1967; see also Smirnov, 1966b, 1966b/1973) that was incidentally discovered in our work on the project on the role of the Vygotsky school in the history of Soviet psychology (Yasnitsky, 2008; Yasnitsky and Ferrari, 2008a, 2008b). This later study by Istomina, despite the popularity of her classical 1948 research, remains virtually unknown to date. Interestingly enough, the findings of Ivanova and Nevoennaia's replication were most closely "prereplicated" by Istomina (1967). Istomina's studies done in the 1960s generally seem to confirm the conclusion of the historical evolution of involuntary mnemonic processes in children. On the other hand, this research seems to undermine the conclusion that the evolution of mental functions observed in the study of Ivanova and Nevoennaia took place over the course of fifty years; instead twenty (!) years had passed since Istomina's research of the 1940s, retrospectively, suggesting that there was no historical development of mnemonic processes from the 1960s on (for a discussion of these replication studies, see Yasnitsky, Falenchuk, and Ferrari, 2008).

Our study presents yet another replication that was done specifically to investigate the historical development of the processes of involuntary remembering over the past sixty to seventy years. Historical data of the 1930s are compared with the contemporary data obtained in a series of experiments conducted in the 2000s. To that end, our study was organized as the closest possible replication of Zinchenko's study on involuntary remembering as a function of activity (Zinchenko, 1939/1983).

The original design of Zinchenko's study involved five groups of participants (junior preschoolers, senior preschoolers, junior schoolchildren, senior schoolchildren, and adults); however, only the three older groups provided the principal data for his study (see Table 1). The same set of fifteen cards with pictures in the center and the numbers in the top-right corner of each of the cards was used in the two experimental series with two different groups of subjects. In the first experiment the subjects were given the task of classifying pictures, whereas the numbers on the cards remained in the background. In the second experiment, the task was to order the numbers and the pictures were the background.

After completing the task the subjects of each of the two experiments were suddenly asked to remember both the pictures and the numbers on the cards. The recall of the pictures and the numbers as the goal and the background of some non-mnemonic activity in Zinchenko's study provided data on involuntary remembering as the function of activity. In addition to the two experimental series aimed to investigate the processes of involuntary remembering, Zinchenko organized another two experimental series aimed at investigating the processes of voluntary, deliberate memorization, most reminiscent of A.N.

Leontiev's research on mediated memory conducted under the supervision of Vygotsky (Leontiev, 1931). Comparative analysis of involuntary and voluntary remembering proved most fruitful, revealing, for instance, that all the subjects who were engaged in a meaningful activity remembered the material that was the goal of such activity ("active involuntary memorization") considerably better than in the conditions of deliberate memorization ("passive, immediate, nonmediated voluntary memorization"). Meshcheryakov refers to Zinchenko's memory effect as "*the activity effect*—performing a cognitive task through active means (e.g., classification, creating an outline, selecting words, deriving words with particular properties) leads to better involuntary mastery of material compared with voluntary memorization without sufficient mental processing of the material" (p. 36).

In our study, several digressions from Zinchenko's original design are notable. First, to compensate for the lack of empirical data collected in individual experiments (354 participants), Zinchenko conducted an additional set of group experiments (2,460 participants) with the same set of cards used in the individual studies, whereas the design of the individual experiments was slightly modified for the experiments in groups (Zinchenko, 1939, p. 166; 1939/1983, pp. 82–83). Yet, the advances in inferential statistics over the past seventy years allow us to avoid the group experiments in our replication study. Second, in order to investigate historical development in the processes of involuntary remembering, in our study, we focused on the three main groups of Zinchenko's study participants, namely, the junior and intermediate schoolchildren, and the adults. Thus, we excluded the data on the preschoolers. Third, unlike Zinchenko (1939), we did not investigate voluntary memorization, and, thus, collected data only on involuntary remembering in schoolchildren and adults (i.e., used only Zinchenko's series 1 and 2, but not series 3 and 4). In sum, Danziger and Shermer (1994, p. 18) point out that "as no two experiments can ever be identical, an acceptable replication will be one characterized by an *acceptable degree of similarity* in the conditions under which phenomena are created," and we believe that our study fully meets this requirement of a replication study. Preliminary results of this study have been reported several times elsewhere (Ivanova and Mazhirina 2008; Mazhirina 2005a, 2005b, 2006, 2007), yet the present article presents a substantial reassessment and reinterpretation of our findings and previous conclusions.

## Method

### *Subjects*

Our study used a sample selected in the Kharkov region in Ukraine. It is important that our sample was selected from the same geographic location as the sample in Zinchenko's original study. Since the ethnic and cultural composition of Ukrainian population has not changed much since Zinchenko conducted his study, we can be

Table 1

**Distribution of Subjects in Each Age Group in Zinchenko's 1939 Study**

| Experiment | Junior school | Middle school | Adults | Total |
|---|---|---|---|---|
| Experiment no. 1: classification of pictures | 47 | 46 | 25 | 118 |
| Experiment no. 2: arrangement of number line | 40 | 45 | 39 | 124 |
| Total | 87 | 91 | 64 | 242 |

Table 2

**Distribution of Subjects in Each Age Group in Our Study**

| Experiment | Junior school | Middle school | Adults | Total |
|---|---|---|---|---|
| Experiment no. 1: classification of pictures | 56 | 56 | 30 | 142 |
| Experiment no. 2: arrangement of number line | 57 | 55 | 30 | 142 |
| Total | 113 | 111 | 60 | 284 |

more confident in attributing observed differences, if any, to historical change, and not to ethnic and cultural differences related to geographic location.

Similar to Zinchenko's sample (see Table 1), our sample consisted of junior (ages eight to eleven) and senior (ages eleven to fourteen) schoolchildren and adults. The numbers of subjects in each age group in each of the experiments are provided in Table 2.

The subjects participating in the study were white Caucasians from various socioeconomic status backgrounds. These characteristics of the sample reflect the population characteristics of Ukraine in general and are assumed to be relatively similar to the characteristics of the sample used in the original Zinchenko study.

### *Experimental materials*

Stimuli materials included fifteen cards with pictures and numbers on them. Pictures were colored and placed in the center of each card; numbers were black and placed in right corner of each card. Pictures contained objects familiar to children. Twelve

of the fifteen objects could be classified into four groups: (1) kitchen utensils—a cup, a pot, a teapot; (2) toys—a drum, a ball, a teddy bear; (3) fruits—an apple, a pear, raspberries; and (4) farm animals—a horse, a dog, and a chicken. The other three objects were a pair of shoes, a gun, and a bug. All but one of the images were the same as the those used in the original Zinchenko study (we had to replace "a gas burner" with "a pot" because modern children might not be familiar with this object). The numbers were: 1, 7, 10, 11, 16, 19, 23, 28, 34, 35, 39, 40, 42, 47, 50.

### *Procedure*

The procedure used in this study involved two experiments, each using the same stimuli material. However, the pictures and numbers on the stimuli cards were used in different ways in the two experiments, either as the goal or the background of action. The experiments were conducted individually with each of the 284 subjects (142 subjects participated in each experiment) according to the procedures described below.

*Experiment no. 1: Classification.* In this experiment, pictures were used as the objects of classification and numbers were used as background objects. The task given to subjects was "to categorize cards into groups based on the content of presented images of objects, and put aside the cards that cannot be categorized." After the task was complete, the cards were taken away from the subjects. Unexpectedly, the subjects were asked to recall the names of the objects and numbers presented on the cards.

*Experiment no. 2: Number line.* This experiment used numbers as the objects of action and pictures as the background of this action. The subjects were asked to put the cards into a twelve-cell frame and a three-cell column using the numbers presented on them in ascending order. The cards were shuffled before the experiment so that the number on them did not follow any certain order. The task was to arrange the cards in ascending order filling in the cells of the frame and the column. When the task was complete, the cards were removed. The subjects were asked to recall the numbers and the names of the objects on the cards.

### *Analyses*

The analyses for this study were conducted in two phases: (1) quantitative analyses of the data obtained in our two experiments; and (2) comparison of our results with the data from the original Zinchenko study.

The aim of the first phase was to investigate involuntary memorization in the two experiments by comparing the average number of the remembered items across age groups and between the experiments. The goal of the second phase was to examine change in involuntary memorization between the mid-1930s when Zinchenko's experiment was conducted and the beginning of the 2000s when our data were collected. Analyses for the two phases of this study were conducted by means of both

descriptive and inferential statistics. Error bar plots were used for visual analysis of the data. Independent sample *t*-tests were used to compare the average number of the memorized goal and background of action items within each age group in the first phase of the study. One-way ANOVAs were conducted to examine developmental trends in the number of memorized objects (goal and background of action material) across the three age groups within each experiment. One-sample *t*-tests were used to compare the average number of pictures and numbers memorized in each age group with the numbers reported by Zinchenko. The average number of memorized pictures and numbers reported by Zinchenko served as test values in these analyses. The overall significance level used in the study was 0.05 and was adjusted for each *t*-test with Bonferroni correction.

## Results

### *Contemporary data*

The mean numbers of pictures and numbers memorized in each of the two experiments are shown in Table 3. The patterns of results are immediately apparent and suggest that in both experiments the average number of memorized goal of action items, whether pictures or numbers, is considerably larger than the average number of background action items. This pattern holds in all age groups.

Comparison of the average numbers of memorized objects across age groups reveals another pattern. While the average number of memorized goal of action items follows developmental progression and seems to increase with age, the average number of background of action items remains almost the same across all age groups.

Figure 1 displays the means and 95 percent confidence intervals around them and allows us to compare the number of recalled goal and background items in the two experiments and evaluate whether differences observed in the sample used in this study are likely to be statistically significant. As can be seen from Figure 1, memorization of the goal of action material is similar in both experiments. It means that memorization of pictures and numbers is similar when they are actively used in the task. A different pattern emerges for memorization of pictures and numbers as the background of action. Subjects in all age groups tend to recall a considerably larger number of pictures then numbers when they are not used in the task.

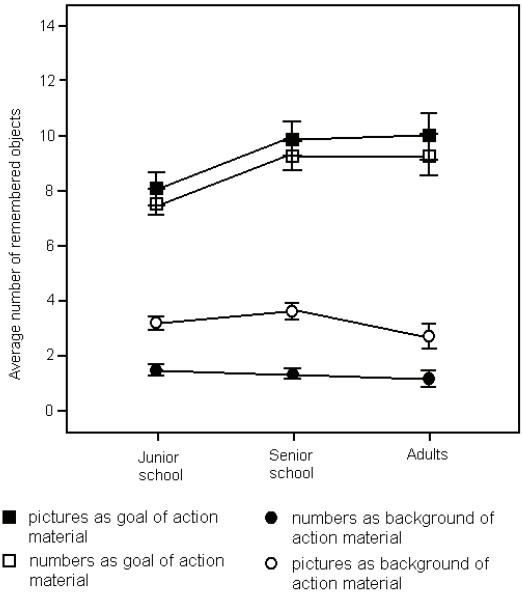
To compare the average numbers of recalled objects across the age groups, one-way ANOVA analyses were conducted for goal and background of action material in each experiment. The number of objects recalled was used as the dependent variable in these analyses, and the age-group variable with three levels served as a factor. The results of ANOVA analyses showed that the memorization of pictures as goal of action was different across the age groups, $F(2, 141) = 13.47$, $p < 0.001$, $\eta^2 = 0.16$ indicating moderate effect size. The same finding holds for numbers as goal of action, $F(2, 141) = 11.33$, $p < 0.001$, $= 0.14$. Post hoc comparisons indi-

Table 3

**Means and Standard Deviations of the Number of Recalled Objects**

| Experiment | Material and its role in action | Junior school | Middle school | Adults |
|---|---|---|---|---|
| Classification of pictures | Goal of action (pictures) | 7.6 | 9.3 | 9.3 |
| | | (1.8) | (2.0) | (2.0) |
| | Background (numbers) | 1.5 | 1.4 | 1.2 |
| | | (0.7) | (0.7) | (0.8) |
| Arrangement of number line | Goal of action (numbers) | 8.1 | 9.9 | 10.0 |
| | | (2.2) | (2.3) | (2.3) |
| | Background (pictures) | 3.2 | 3.6 | 2.7 |
| | | (0.9) | (1.1) | (1.2) |

Figure 1. **Average Number of Recalled Goal and Background of Action Items in the Two Experiments**



cated that the average number of goal of action items recalled by subjects in the junior school group was significantly lower than the average number of objects recalled in both senior school and adult groups ($p < 0.001$ for both analyses). The results of ANOVA analyses for recall of numbers as background of action were not significant, $F(2, 141) = 1.95$, $p = 0.146$, $\eta^2 = 0.02$, indicating that the average number of recalled numbers in the classification experiment was similar across the three age groups. However, the average number of recalled pictures as background stimuli was significantly different, $F(2, 141) = 7.04$, $p < 0.001$, $\eta^2 = 0.09$ indicating small effect size. Post hoc comparisons indicated that the average number of pictures recalled by senior school children was different from the average number of pictures recalled by adults ($p < 0.001$).

Independent samples *t*-tests were conducted to compare the number of recalled goal and background of action items within each age group in the two experiments. The results of the tests indicate, that the average number of recalled pictures and numbers as goal of action was not significantly different for any of the age groups: $t(111) = -1.263$, $p = 0.209$ for junior school children; $t(109) = -1.508$, $p = 0.135$ for senior school children; and $t(58) = -1.204$, $p = 0.233$ for adults. However, the average number of recalled pictures as background of action was significantly larger than the average number of recalled numbers as background of action in all three age groups: $t(111) = -10.744$, $p < 0.001$, Cohen's $d = 2.02$ for junior school children; $t(109) = -12.703$, $p < 0.001$, Cohen's $d = 2.41$ for senior school children, and $t(58) = -5.867$, $p < 0.001$, Cohen's $d = 1.51$ for adults).

### *Historical comparison*

To explore whether the processes of involuntary memorization have changed in the past seventy years, our results were compared with the data reported by Zinchenko in his original study conducted in the mid-1930s and published in 1939.

Table 4 contains the average number of recalled objects in each age group in Zinchenko's experiment.

Figures 2 and 3 display the data for classification of pictures and arrangement of number line experiments, respectively. Each figure contains four lines reflecting the memorization of goal and background of action in Zinchenko's study and in our study. The curves corresponding to our data reflect the average number of recalled items in each age group as well as the 95 percent confidence intervals around them. Confidence intervals for Zinchenko's study could not be computed, as the author did not report standard deviations for group means.

As can be seen from Figure 2, the number of recalled pictures in the classification experiment is considerably smaller in our study in comparison with Zinchenko's data. This trend can be observed in all three age groups. At the same time, the number of recalled background objects (numbers) in this experiment slightly increased in senior schoolchildren and adults.

A different picture emerges for the arrangement of the number line experiment.

Table 4

**Means of the Number of Recalled Objects in Zinchenko's Study**

| Experiment | Material and its role in action | Junior school | Middle school | Adults |
|---|---|---|---|---|
| Classification of pictures | Goal of action (pictures) | 13.0 | 13.4 | 13.2 |
| | Background (numbers) | 1.6 | 1.1 | 0.7 |
| Arrangement of number line | Goal of action (numbers) | 9.9 | 10.3 | 10.2 |
| | Background (pictures) | 2.3 | 1.3 | 1.3 |

Figure 2. **Comparison of the Data from the Classification Individual Experiment with Zinchenko's Study**

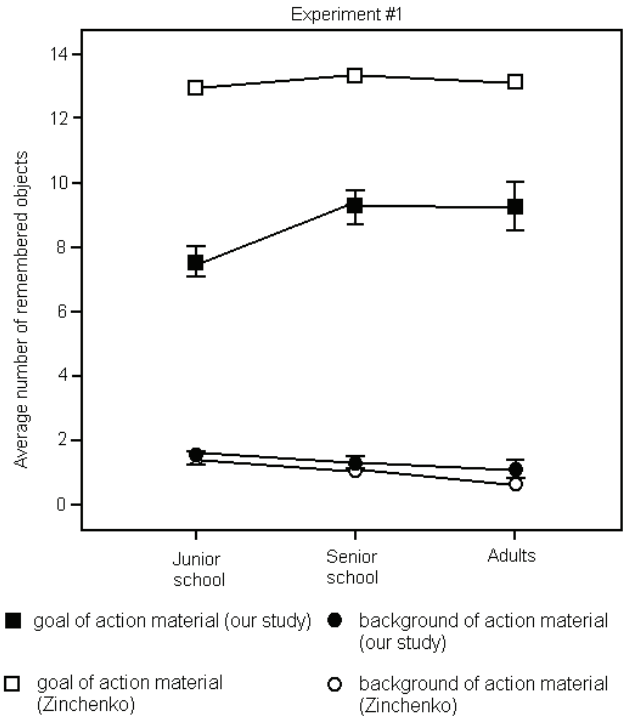
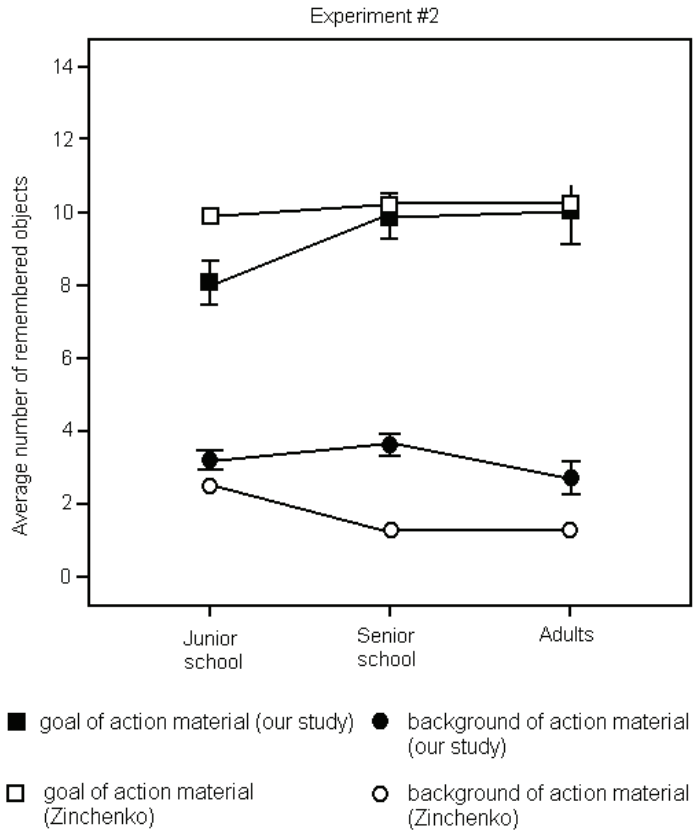


Figure 3. **Comparison of the Data from the Arrangement of the Number Line Experiment with Zinchenko's Study**




Although junior school children seem to recall fewer numbers as goal of action nowadays, the number of recalled goal of action items is hardly different from Zinchenko's data for the other two age groups. In contrast, the number of pictures recalled in this experiment seems to be larger for all age groups in our study. One-sample *t*-tests (Table 5) conducted within each age group confirm the pattern observed in Figures 2 and 3. As can be seen from Table 5, the average number of pictures remembered nowadays and in Zinchenko's study is significantly different with a large effect size in all age groups in both experiments. The average number of numbers remembered in the classification experiment is significantly different between our sample and Zinchenko's data in the two older age groups. However, the effect size of these differences is moderate. And, finally, the number

Table 5

**Comparison of Recall with Zinchenko's Study**

| | | Goal of action objects | | | Background of action objects | | |
|---|---|---|---|---|---|---|---|
| Experiment | Age group | Mean difference between our data and Zinchenko's | *t* | Effect size (Cohen's *d*) | Mean difference between our data and Zinchenko's | *t* | Effect size (Cohen's *d*) |
| Classifying pictures | Junior school | –5.4 | –22.7** | 3.03 | –0.1 | –1.0 | 0.13 |
| | Senior school | –4.1 | –15.3** | 2.04 | 0.3 | 2.8* | 0.37 |
| | Adults | –3.9 | –10.7** | 1.95 | 0.5 | 3.2* | 0.58 |
| Ordering numbers | Junior school | –1.8 | –6.1** | 0.81 | 0.7 | 5.7** | 0.75 |
| | Senior school | –0.4 | –1.2 | 0.16 | 2.3 | 15.6** | 2.10 |
| | Adults | –0.2 | –0.5 | 0.09 | 1.4 | 6.4** | 1.17 |

Table 6

**Number of Subjects Remembering No Background of Action Objects in Individual Experiments**

| | Classification experiment: nonremembering background numbers | | | | Ordering numbers experiment: nonremembering background pictures | | | |
|---|---|---|---|---|---|---|---|---|
| | Our study | | Zinchenko | | Our study | | Zinchenko | |
| Age group | *N* | % | *N* | % | *N* | % | *N* | % |
| Junior school | 4/56 | 7.1 | 8/47 | 17.9 | 0/57 | 0.0 | 4/40 | 10.0 |
| Middle school | 4/56 | 7.1 | 23/46 | 50.0 | 0/55 | 0.0 | 14/45 | 31.1 |
| Adults | 5/30 | 16.7 | 13/25 | 52.0 | 0/30 | 0.0 | 9/39 | 23.1 |
| Total | 13/142 | 9.1 | 44/198 | 37.2 | 0/142 | 0.0 | 29/154 | 12.1 |

of remembered items in the number line experiment is different only in the junior school group. The effect size of this comparison is large.

To further explore historical changes in involuntary memorization processes, a number of subjects who could not recall any background objects was computed for each age group in both experiments and compared with the original data reported by Zinchenko (Table 6). Comparison of the results across the two experiments indicates that a few subjects could not remember any background of action number, but all subjects recalled at least one picture as a background of action object in our study. This pattern holds in all age groups. Comparison of our data with Zinchenko's study shows that a considerably smaller number of our subjects could not remember any background of action objects. This is true for both pictures and numbers as background of action objects.

### *Preliminary Summary of Findings*

Contemporary data:

1. Goal of action material is remembered significantly better than the background of action material, a finding that holds for both experiments.
2. On average, pictures and numbers as the goal of action are remembered equally well in each age group.
3. Numbers as the background of action are remembered more poorly than pictures as the background of action.
4. The spurt in the growth of recall rate of the goal of action material takes

place in children with the transition from junior school to senior school age.

5. Recall of numbers as the background of action was similar in all age groups; for pictures, a slight increase between junior and senior schoolchildren was found, whereas the major decrease in recall rate takes place between senior schoolchildren and adults.

Historical comparison:

6. Remembering pictures as the goal of action material decreased whereas as the background of action increased compared with Zinchenko's study.
7. Regardless of their place in the structure of action, remembering numbers did not change significantly as compared with the Zinchenko study, the only exception being that the recall of numbers as the goal of action is significantly poorer in contemporary junior school children.
8. Nonremembering rate of the background material changed significantly: at least one background item is remembered in most cases for numbers and even for all pictures.

## Discussion

With some caution we discuss the discovered effects of historical development of involuntary remembering over the past seventy years, specifically, the two major findings of Zinchenko's study, the *activity-structure* effect and the *negative effect of age*. We argue that the comparison between Zinchenko's data and contemporary data reveals interesting trends in historical change in involuntary remembering and poses new research questions that were beyond the scope of the original Zinchenko study.

Generally, our study clearly confirms the *activity-structure* effect: the material that constitutes the goal of action is remembered considerably better than the background of action material. However, the most significant difference between contemporary data and Zinchenko's data is in the recall of visual, pictorial information. Thus, we can clearly see a decline in remembering pictorial information as the goal of action, and, strikingly, the very same pictures as the background of action are remembered better than seventy years ago. On the other hand, the rate of remembering numbers has virtually not changed between then and now. Thus, our major finding seems to be the change in the way the participants of our study operated with visual material, and the two seemingly opposite tendencies of decrease in the recall of goal of action material and increase in the recall of background of action material are apparent.

We attribute this historical change in visual information processing to the role of visual information in everyday life of people these days. Television, computers, graphical advertisement, and so on are the signs and major vehicles of this change. Psychologically, this has led to differences in visual information processing now

as compared with the time when Zinchenko's study was done: operating with visual information has become a habitual everyday psychological process that takes places largely automatically and requires considerably smaller mental effort on the part of our contemporaries when processing visual information constitutes the goal of an action.

The phenomenon of the increase of visual background information recall is closely related in our study to the other remarkable effect discovered by Zinchenko. The *negative effect of age* in our study was only partially confirmed by the decline of recall of background pictorial material from the middle school age to adults. On the other hand, pictures as background of action are remembered considerably better nowadays than they were seventy years ago. It seems that the differences between Zinchenko's and contemporary data on involuntary remembering of background of action material highlight the differences between the two kinds of involuntary remembering. Thus, whereas remembering goal of action material is a function of some conscious meaningful activity with specific objects, remembering background of action is a "product of various orienting reactions that were caused by the same objects as background irritants. These reactions are not related directly with the object of goal-driven activity. . . . This type of remembering was called 'incidental' remembering. In fact, even this type of remembering is not essentially incidental" (Zinchenko 1961). So, what are the psychological mechanisms of these processes and how can we explain the differences between our findings and Zinchenko's conclusions?

The most obvious and straightforward explanation for the observed phenomenon of changes in remembering background material seems to be the same as with remembering goal of action material: the different role of visual information in the contemporary world determines changes in its processing. This explanation, which we presented elsewhere (Ivanova and Mazhirina, 2008), looks quite plausible, but now we have certain reservations about it. There are two reasons for our concerns in this respect. First, although the recall of pictorial material in our study significantly outnumbers that in Zinchenko study, remembering numerical background of action material in the contemporary study is also slightly better. Second, the indicators of the rate of nonremembering background of action material in Zinchenko's (1939) and our study suggest that a radical qualitative shift has occurred: the nonremembering rate dramatically dropped from the 1930s to now from up to 50 percent of *nonremembers* in Zinchenko's study to very insignificant numbers of *nonremembers* in our study. We hypothesize that this tendency to better remember the background of action—that was so clearly observed in the case of visual information—can be generalized to any, nongraphic background of action information. The everyday world of contemporary people, overloaded with meaningful socially accepted signs virtually everywhere, is very rich in information and extremely semantically charged. Thus, contemporary people seem to have a predisposition, an unconscious orientation to processing background information as potentially important and meaningful. Visual, graphical input seems to be significantly more important in the

semiotic system of the everyday social environment of our contemporaries, which is evident in the better recall of visual material as background of action.

This finding was anticipated in the discussion of the differences between voluntary and involuntary memorization presented by Anatolii Smirnov, a prominent Soviet scholar and, along with Zinchenko, another leader of memory research in the Soviet Union in the 1930s to 1970s. Thus, Smirnov wrote:

> The difference between these types of memorization is quite justified. But it would be incorrect to interpret this difference as absolute. Undoubtedly, a series of transitions, or intermediary forms, exists between voluntary and involuntary memorization. One type is the memorization accomplished not by conscious intention to remember, nor under the influence of a mnemonic problem, but as a result of the presence of a mnemonic set. Such memorization is not voluntary inasmuch as voluntary memorization is intentional, but at the same time it is characterized by a more or less pronounced mnemonic orientation which does not occur in involuntary memorization. Therefore, it cannot be regarded as a relatively incidental mnemonic effect of an activity directed towards another goal—as is characteristic for involuntary memorization. This is undoubtedly one of the transitional forms between voluntary and involuntary memorization. (Smirnov, 1966a; 1966a/1973, p. 26).

The unconscious orientation toward processing background information seems to stand behind one of these "transitional forms of memory between voluntary and involuntary memorization" that our study seems to reveal.

The phenomenon of a contemporary person's unconscious orientation to processing background information entails quite interesting interplay with the negative effect of age discovered by Zinchenko. Indeed, unconscious orientation to processing background information seems to develop in early childhood and results in better recall of background information in older children and adults, whereas, according to the negative effect of age, the recall of background information, on the contrary, is better in younger children and gradually decreases with age! Our data demonstrate traces of both of these processes; thus, the effect of the unconscious orientation to processing background information seems to overcome the negative effect of age in the case of numbers as the background of action, whereas for pictures as the background of action the negative effect of age is presumably suppressed by the senior school age and reveals itself only after senior school age. At this point we are far from reaching a conclusion about the nature and the effect of such interplay between two seemingly opposite processes, and only further experimental research will shed light on this problem and verify our hypothesized contemporary orientation to background of action information processing.

There are other questions open for future research. Thus, unlike Zinchenko's study showing that the involuntary remembering of goal of action material increases from early preschool age reaching its peak at junior school age, our study revealed a developmental spurt in involuntary remembering such material at a later stage of the child's development, that is, between junior and senior school age. However,

it is interesting to note that such a spurt between junior and senior school age is demonstrated by Zinchenko in his group experiments. Since group experiments in Zinchenko's study were organized with the purpose of compensating for the limited population size in his individual experiment, he focused on similar trends found in these two experimental settings and never discussed the differences between the two. The differences between the individual and group experimental settings and effect of group dynamics on the processes of remembering remain topics for further investigation.

Finally, how incidental the striking similarity between remembering pictures and numbers as the goal of action was is unclear. With reasonable caution, we propose that there is a process of unification underlying involuntary remembering of pictures and numbers as goal of action. Interestingly, remembering the background of action seems to confirm this hypothesis of unification; indeed, the data on nonremembering of both pictures and numbers as background of action seem to confirm this conclusion. Yet, this is another question to be addressed in future research.

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