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The Phenomenon of Nonconscious Negative Choice

"Nonconscious negative choice" is used as a unifying term explaining the phenomenon of Ebbinghaus's law of memory and change blindness in subliminal visual material. The assumption is that there is a mechanism that makes a decision about what to consciously perceive and what not to. The purpose of this experiment was to test the hypothesis that making a task more difficult influences the probability of a repeated error. The experiment once again confirmed the existence of negative-choice aftereffect in the regular, everyday task of typing a text.

Nonconscious negative-choice aftereffect. A formulation of the problem

Ebbinghaus's law has been well known in memory research for a long time: the number of presentations required to memorize a series grows far more rapidly than the length of the series. For example, Ebbinghaus himself could reproduce six or seven nonsense syllables after one presentation, but in order to memorize twelve syllables he needed fourteen to sixteen presentations. What explains such a sharp increase in the number of presentations? The explanation of such phenomena usually causes difficulties in all theories of memorization. In essence, something that has not received the proper amount of attention, unreproduced characters after the first presentation of the series

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have a tendency not to be reproduced after subsequent presentations of the series as well. After all, memorizing the six nonsense syllables that were not reproduced takes almost fifteen presentations, even though the first six syllables are remembered after the first time.

The phenomenon of change blindness is described as an inability to see changes during a sequential presentation of visual material. In Rensink's (2002) experimental paradigm, a test subject is presented a picture on a computer screen with dark- and light-colored rectangles scattered across it. The picture is presented for a certain amount of time (from 80 to 800 milliseconds), followed by a blank screen. In the next presentation one element is changed. The subject's task is to notice the target (the change in the element) and click the appropriate button. The results showed that test subjects are not able to notice even fairly substantial changes in the pictures. Multiple (see, e.g., the survey by Simons, 2000) and not always intelligible explanations of this phenomenon usually address the physiological component, which in our view avoids a substantive explanation. After all, this effect pertains to the process of conscious perception, which has not been described physiologically at all. Moreover, the data from experiments on change blindness suggest that the unnoticed elements are in fact perceived by the test subject, since he can later recognize them. How can one explain the fact that the test subject persistently continues not to notice certain details in the pictures that are presented?

An essential similarity can be found in the first and second examples: when certain elements are missed (not identified, not reproduced) once, they continue not to be reproduced (not to be identified) afterward. In the early 1970s, V.M. Allakhverdov discovered a phenomenon that was named the "nonconscious negative-choice phenomenon." This empirical phenomenon continues to be studied in the General Psychology Department of St. Petersburg State University [SPSU] under his direction.

A number of experiments showed that in a sequence of tasks of one type the test subject tends to repeat his previous errors and, most improbably, to repeat previous errors of omission. In one experiment (Allakhverdov, 1993) musicians with absolute pitch picked out on a piano nonharmonic chords that were presented (a random set of tones). If in the previous chord a tone was omitted and not reproduced, the probability of a repeat omission of the same tone in the next chord sharply increased. The task of another experiment was to identify trigrams in compound words. For example, *les* [forest] in the word *py-les-os* [vacuum cleaner]. The probability of an error of omission of the target (the trigram) is quite low, only 0.07. However, the probability of a repeated omission of the same target in another word containing this trigram is 0.33 (Allakhverdov, 1993). The probability of making an error in

identifying indicator readings (exposure time 300 milliseconds) is 0.29, but the probability of a repeated error in the next, repeated presentation of the same reading is 0.43.

Negative-choice aftereffect touches on two major problems. The first is the possibility of nonconscious processing of information. The paradoxical nature of the effect is that in order not to reproduce strictly defined elements in a series, the test subject must actually remember them, and then for some reason not select them. In one of the experiments that was conducted members of the General Psychology Department of SPSU (N.A. Ivanova) test subjects performed a sequence of tasks of the same type on a computer (3,000 trials in all). Test subjects were given a simple sensorimotor task—by pressing the space key, they had to launch a projectile toward a target that was uniformly moving in a straight line across the screen. During the experiment, as was to be expected, learning took place—a gradual decrease in the mean error of the responses from the center of the target. At the same time, it was found that the test subjects tended to repeat their responses in two consecutive trials, that is, make the same errors. In order to repeat a error, one must remember the choice made in the previous trial and then know how to repeat it! Furthermore, at the beginning of the learning process the precision with which the test subjects repeated their errors already surpassed not only the precision they achieved at the end of the learning process but even the possibility of conscious discrimination (Ivanova, 2006). We can also list a number of other studies in which the negative-choice aftereffect is observed and, as a rule, is cause for bewilderment. A study by N.I. Chuprikova and V.A. Suzdaleva showed that the presentation of a word of another category before a target word slows the time of reaction to the target stimulus. "In other words, any mental act is based on an evaluation not only of what the verbal stimulus is but also of what it is not" (Suzdaleva and Chuprikova, 1989). The psychophysical experiments of A.P. (1985) recorded a tendency to repeat a response to a signal of the same intensity. How can a test subject in a zone of nondiscrimination of a stimulus determine which response to repeat and which not to repeat? Experiments conducted in the General Psychology Department of SPSU (see the article by V.Iu. Karpinskaia and N.P. Vladykina in this issue) show that repeated errors exist in the nondiscrimination zone and prove that stimulus discrimination in the near-threshold zone does take place.

But if test subjects remember their error in the previous trial, then what prevents them from changing their response to a correct one? In other words, why does a nonconsciously perceived character (an error) remain nonconscious? Negative-choice aftereffect directly pertains to the problem of the selectivity of consciousness. The assumption is that there is a mechanism that makes a decision about what to consciously perceive and what not to. A decision, once

made, influences subsequent choices, engendering a repetition of nonconscious perception (negative-choice aftereffect) and a repetition of conscious perception (positive-choice aftereffect) (Allakhverdov, 1993, 2000).

The question of the relationship between the consciously perceived and the nonconsciously perceived has been raised by various psychological schools. William James explains the phenomenon of the selectivity of consciousness by using the term "psychic overtones." The stream of consciousness consists of a multitude of elements and thoughts describing various qualities of an object. In the process of establishing identity among thoughts about various qualities of the object, consciousness is forced to make a choice among elements. Therefore, psychic overtones are fringe elements of consciousness that it has not selected at a given moment (Galin, 2000; James, 1991). Sigmund Freud's psychoanalysis views repression (in effect, a repeated nonconscious acquisition of information) as a defense mechanism that results from an inner conflict. The defense mechanism, writes Salvatore Maddi, includes the process of expelling from consciousness any images of sensation, perception, thoughts, or actions that would come into conflict with values and principles instilled by society (Maddi, 2002). Despite the absolutely different explanatory paradigm, the concept of repression has an important property that brings it close to the concept of negative choice: "when the conditions for referring to repressed information persist, it has a tendency to remain repressed" (from Allakhverdov, 1993, p. 41). The well-known experiments of Edgar Rubin and the Gestalt psychologists showed that during the perception of ambiguous images, both meanings of the picture cannot be simultaneously accessible to consciousness; one of them will certainly not be consciously perceived. And this is despite the fact that, as was later shown in various kinds of experiments, the subliminal meanings of an ambiguous image are still perceived and exert a noticeable influence on the subsequent activity of test subjects. Even though the above approaches define the possibility of this phenomenon as negative-choice aftereffect, almost nowhere is the effect itself described. To be more precise, in studies the phenomenon empirically manifests itself fairly often, but the researchers themselves usually fail time after time to notice it or formulate it. For example, the tendency to repeatedly consciously perceive what was previously already consciously perceived could be called, along the lines of the Gestaltists, the aftereffect of a figure. The Gestaltists, however, did not seriously examine the aftereffect of the background (i.e., the tendency not to consciously perceive what previously was not consciously perceived). None of them even called attention to the fact that Rubin's classical experiments have a dual interpretation—they may be treated with equal validity as either the aftereffect of a figure or the aftereffect of a background (see Allakhverdov, 1993).

Aspects of the manifestation of negative-choice effect

Negative-choice aftereffect can manifest itself in two aspects:

- a previously not consciously perceived (negatively chosen) character has a tendency to continue not to be consciously perceived if the situation again demands that it be consciously perceived (reproduced, identified, calculated, etc.);
- if the situation changes, a previously negatively chosen character may be consciously perceived (surface in consciousness) at an unsuitable moment (e.g., in the form of an error). For example, omitted signs in an initial reproduction of a series have a tendency to find their way into a subsequent response by the test subject when this character is no longer being presented (Allakhverdov, 1993, 2000).

Both of these aspects are the result of a specific decision to consciously perceive something. The selectivity of consciousness, putting aside external constraints, implies a certain rule under which a decision is made to consciously/nonconsciously acquire information. Attempts to define this rule lead to the problem of defining the functions of consciousness—a question that is just as nebulous and contradictory as the question of what consciousness is. Allakhverdov conjectured that one of the functions of consciousness could be research behavior: testing hypotheses about the environment. If part of the information does not conform to the proposed hypothesis, then it is quite logical that a decision is made to acquire this information nonconsciously. If this conjecture is correct, then negatively chosen information will not remain neutral and may somehow influence conscious activity, at least until the hypothesis proposed beforehand is rejected. This was confirmed in a number of experiments by M.G. Filippova (2006). The study examined the influence of ambiguous images presented at a subthreshold level on the process of performing cognitive tasks. The ambiguous images were presented according to the priming method, and it controlled which meaning of the image was consciously perceived. Parallel with this task, the test subjects performed a number of other tasks (e.g., solving anagrams) semantically related or unrelated to the meanings of the ambiguous image. It turned out that the tasks related to a nonconsciously, negatively chosen meaning of the image took significantly longer to solve (8.51 seconds) than tasks not related to the image (7.48 seconds), and the difference was even greater when compared with tasks related to a consciously perceived meaning of the picture (6.46 seconds). The writer concludes that the very presence of nonconsciously perceived meanings slowed the performance of cognitive tasks.

If the situation changes, nonconsciously acquired information may spon-

taneously manifest itself in consciousness. An altered situation also prompts a change in the research hypothesis to be tested by the consciousness. The need for sustained nonconscious acquisition of information disappears, and it is precisely at that point that this information can become consciously acquired. The simplest criterion for a change in the situation is time. With time the environment changes objectively, that is, one need simply wait a little and a negative choice will automatically manifest itself in consciousness. Is this true?

This effect is clearly evident in the case of the phenomenon of reminiscence. Reminiscence is a phenomenon of reproduction of information that previously could not be recalled. For some reason, a single presentation of a number of characters causes an improvement in the reproduction of the series upon repeated testing. According to the hypothesis, a decision to consciously or nonconsciously perceive something tends to have an aftereffect. In the first presentation of the series a certain number of elements were reproduced (positively chosen) and not reproduced (negatively chosen). If this testing had been followed immediately by a second attempt at reproduction, the tendency toward negative choice would have solidified and persistent errors would have occurred. But a condition of reminiscence is a certain temporal gap between the first and next reproduction of the material. And it is this temporal interval that is the turning point: previously nonconsciously acquired information abruptly appears in the conscious zone. A study by Mulligan (2006) showed that the reproduction of a series of stimuli sequentially in two testing procedures with a seven-minute gap between them leads to a greater effect from reminiscence than a single testing procedure lasting ten minutes immediately after presentation of the stimulus material. This confirms the above conjecture regarding the mechanisms of actualizing negatively chosen (not reproduced) information.

What happens when information that has been nonconscious for some time suddenly appears in consciousness as a result of a change in the situation. As we recall, negatively chosen information is not neutral with respect to the hypotheses being processed by the consciousness, and one can assume that its actualization will lead to new hypotheses, new conjectures. The experiment with ambiguous images already described above (Filippova) showed that if in the process of performing cognitive tasks the test subjects consciously perceived previously nonconsciously perceived meanings of an ambiguous image, cognitive tasks of any type (related and unrelated to the consciously perceived meaning of the image) were performed much more quickly (Filippova, 2006). This phenomenon is similar to the phenomenon of insight and incubation. When performing creative tasks during the incubation stage, an individual puts aside the task for a while and switches to another activity. It is assumed

that during this stage the task is being processed in "background mode," in the realm of the unconscious (dreams, associations, etc.). Incubation directly precedes the phenomenon of insight. In terms of the negative-choice aftereffect, the incubation phase is critical to the emergence of insight. Changes in the task lead to the presentation of other elements. The temporal component itself, as was shown above, can influence the redistribution of nonconsciously and consciously acquired information. At a certain point a decision to nonconsciously perceive previous elements in a sustained manner ceases to apply and it becomes likely that they will appear in consciousness. Any methods of interpreting the task—including what would seem to be the most improbable ones—and some options for solving it are produced virtually instantaneously and simultaneously at the subliminal level. The emergence of these previously nonconscious options for a solution in consciousness may lead, in the final version, to a creative solution of the task and the experiencing of insight (Allakhverdov, 2006).

Conditions of the manifestation of the negative-choice effect

Obviously, not all nonconsciously acquired information is subject to a negative-choice aftereffect. What conditions are necessary for the best manifestation of the effect? The aftereffect is observed in repeated errors of substitution and errors of omission. Obviously, the high probability of making any error will bring about an increase in the proportion of repeated errors. Experiments by Allakhverdov in the 1980s showed that a tendency to repeat an error in mnemic tasks occurs when the success rate in performing the task is more than 50 percent but less than 80–90 percent (Allakhverdov, 1993), that is the proportion of errors should be between 20 percent and 50 percent.

The purpose of this experiment was to test the hypothesis that making a task more difficult influences the probability of a repeated error.

Method

The experiment had twenty participants, students at higher educational institutions in St. Petersburg (average age twenty-one). All of the test subjects were inexperienced computer users and were not very skilled at typing. The test subjects were given a simple task—to type on the computer, at a pace comfortable for him/her, one page of text that was given them. After a short break (five minutes) they were asked to type one more page of text, but this time as quickly as they could. The main condition in the first and second trials was not to correct errors and not to monitor the quality of the typed text. To fulfill this condition better, the monitor was turned on, and the test

Table 1

Probability of an Error in Typing Text (mean for group)

Task type	At first presentation of word in text	At repeated presentation of word, given that an error was made at previous presentation
Typing at comfortable speed for test subject[1]	0.15	0.40
High-speed typing[2]	0.19	0.52

[1]Pearson χ^2, $p < 0.01$.
[2]Pearson χ^2, $p < 0.01$.

subject typed blindly. The selected texts were highly connected (the number of recurring words was quite large, but did not exceed 45 percent). In all, the texts (nos. 1 and 2) contained 380 words. Measurements were taken of the total typing time and the number and nature of the errors made.

Results

The mean typing time for the first text was thirty-six minutes; for the second, fifteen minutes. The mean number of errors (repeated and single ones) in the first text was thirty-four; in the second, fifty-four. Fifteen of the twenty people made repeated errors, which accounted for 1–61 percent of all errors. For the other five people the total number of errors did not exceed 5 percent of the entire text. The result of the experiment is presented in Table 1. At both typing speeds the probability of making a repeated error in word, given that an error had already been made, was significantly higher than the theoretical probability of a error.

The experiment was also intended to test the hypothesis that repeated errors will occur more often in a situation when the conditions of the task are made more difficult by increasing the typing speed. The difference between the number of repeated errors in the two texts is statistically significant (Wilcoxon, $p < 0.01$).

Conclusions and discussion

This experiment once again confirmed the existence of negative-choice aftereffect in a regular, everyday task of typing a text. The probability of making a repeated error during high-speed typing is greater than the probability if typing

a text at a regular pace. Various experiments by our group showed (Allakhverdov, 1993, 2006) that negative-choice aftereffect is better observed when the probability of making an error is fairly high. Why does this condition apply? I believe that increasing the difficulty of a task, increasing the work speed, and the higher probability of an error contribute to an overall increase in the uncertainty of the situation for the consciousness. And when the environment is indeterminate, it is harder for the consciousness to reject a hypothesis once it has been advanced. The concept of negative choice implies that negatively chosen information is not neutral to the consciousness. It is clearly in conflict or inconsistent with consciously acquired (positively chosen as of that moment) information. Therefore, the negative-choice aftereffect comes into play: once information has been nonconsciously acquired, it continues to be nonconsciously perceived. Perhaps that is the reason that the negative choice aftereffect cannot be detected in a situation where there is no ambiguity or complexity in interpreting stimuli, the probability of a error is not high, and there are no other factors increasing uncertainty.

True, similar data were presented in a different interpretation by Lewicki Hill, and Sasaki (1989). During the experiments they detected a phenomenon that they called "self-perpetuating development of encoding biases." The experiment consisted of two parts (a learning phase and a testing phase). In the learning phase, the test subjects acquired an implicit pattern, such as the distribution of test stimuli (digits) among matrixes. In the testing phase, the test subjects were presented the same matrixes for a short time (100 milliseconds), but without the test stimuli. In their place were neutral numbers that had previously not been presented. Nevertheless, the task remained the same—to detect the stimulus and click on the appropriate button. The fact that interested Lewicki was that with time the test subjects more and more accurately assigned matrixes not containing the target stimulus to various classes in accordance with the pattern they had assimilated. This phenomenon, in the writers' view, could be evidence not only that an encoding rule is learned but also that there is a certain mechanism of self-perpetuation of an encoding rule. The writers do not give a detailed explanation of this discovery. At first glance, this result is inconsistent with the hypothesis of negative choice: with time the accuracy of incorporating the implicit pattern increases. But as a result, there is no tendency to repeat previous errors, which could indicate a negative-choice aftereffect. The control phase of the experiment, however, proceeded in a completely indeterminate situation; there were no correct responses at all, since none of the matrixes contained the target stimulus—they had been replaced by other, neutral ones. The test subjects simply applied the rule they had previously learned to the new material, in which they had persistently failed to notice the absence of the target stimuli and that they

had been replaced by other digits. In a situation of complete indeterminacy we see the clearest manifestation of the effect of nonconscious perception of previously nonconsciously perceived elements.

The test subjects who made many repeated errors of one type usually noticed that they were making them. When typing on a computer, a situation often arises in which we persistently make the same errors, but even if we know about these errors, we continue to repeat them and only later correct them. A negatively chosen meaning (an error of omission or substitution), once chosen, continues to be negatively chosen even when the presence of this error is consciously perceived. It is impossible to remove a previously negatively chosen meaning with a simple conscious effort; after all, it was nonconsciously perceived as a result of a specific choice. The mechanisms of controlling the choice of what should be consciously perceived cannot be conscious. But the fact that we can sometimes partially consciously perceive the result of a nonconscious negative choice may indirectly demonstrate various levels of conscious/nonconscious perception.

This experiment demonstrated once again the existence of nonconscious negative choice in the case of skills in typing a text. Despite the existing empirical fact, the phenomena of negative-choice aftereffect are rarely mentioned in the literature, if only because of their paradoxical quality. The studies described in this article allow us to assert that:

- There is a specific decision-making mechanism in regard to the conscious or nonconscious acquisition of information;
- The negative-choice aftereffect is a result of a specific decision not to consciously acquire what has previously been nonconsciously acquired; and
- A decision to nonconsciously perceive something typically leads to repeated errors.

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