On Processing in the Inattention Paradigm as Automatic

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ABSTRACT: In the critical trial of the "inattention paradigm" about 25% of the participants did not notice the target stimulus. A significant percent of these "inattentionally blind" subjects did not detect the target objects when explicitly asked about them. Nevertheless, in an implicit test these subjects showed that the target objects were processed. The "inattentionally blind" subjects in the inattention paradigm are blind to the critical stimulus in the same sense that subjects in the Stroop task are blind to the meaning of the presented words. In both cases blindness reflects the limitations of the representations resulting from automatic processing. Therefore, these results are best conceptualized as indicating automatic processing of unattended stimuli.

1. Introduction

In the "inattention paradigm" of Mack and Rock (1998) participants in all trials had to decide which arm of a presented cross was longer. In a critical trial (a single one in each study) a target stimulus was presented in parallel, and the participants were later asked whether they noticed it. About 25% of the participants did not notice the target stimulus and this percentage increased to about 80% when the critical stimulus was presented at

the fixation point. Furthermore, a significant percent of those that didn't detect the target objects when explicitly asked about them showed in an implicit test that they did process them. In the present commentary I wish to argue that the results obtained in the inattention paradigm are best conceptualized as indicating automatic processing of unattended stimuli.

2. Analysis of the Inattention Paradigm

In the inattention paradigm the subject is asked to report which arm of a presented cross is longer. In the critical trial another object is presented at the same time, with the critical stimulus appearing close to fixation. Immediately after, the subject is asked whether she /he has noticed something on the screen other than the cross. The instruction given to the subject defines the cross as the attended object or as the object of focal attention (Neisser, 1967). Consequently, any other object appearing in the field is assumed to be ignored.

Pashler (1998) pointed out that two concepts have been discussed in the context of attention; selection and capacity. Mack and Rock (1998) emphasize that their use of the term "attention" focuses on selective attention. In the inattention paradigm *instructions guide selection;* the cross is selected for intentional processing. However, as Mack and Rock (1998) show in their own experiments that attentional resources are not limited to the objects selected by instructions but cover a whole zone in the physical space around it, inattentional blindness is of the same magnitude when the critical object is located on the cross and when it is located in one of its quadrants. If the task slightly changes so that a rectangle is presented instead of the cross and the subjects have to decide which of its dimensions (height or width) are longer, inattentional blindness is larger within the rectangle than the area spread around the outside of it. This is consistent with the spotlight notion (Posner, 1980; Treisman & Gormican, 1988) of attention as focusing over a region in space and not being constrained to a specific object. The CODE component of Logan's (1996) CTVA theory specifies a possible mechanism for focusing attention on a region in space. Within this region objects may be selected intentionally for further processing. Intentional selection of "objects" *within the focus of attention* is at the center of Mack and Rock's experiments. This analysis emphasizes that there is more to attention that just intentional selection. In the remaining part of this commentary I suggest that what the authors refer to as unintentional blindness is best conceptualized as unintentional, and thereby automatic, processing.

3. On Defining Automaticity

Hasher and Zacks (1979), and Posner (1978) defined automatic processes as being attention free, unconscious, and involuntary. It is rarely the case however, for all three features to hold simultaneously (see Neumann, 1984; Carr, 1992; for reviews). Bargh

(1989, 1992) pointed out that the ability of a process to run to completion once started, without the need of conscious monitoring, is common to all automatic processes, and Tzelgov (1997) proposed the adoption of processing without monitoring as the definition of automaticity. By monitoring I mean intentional setting of the goals of processing and intentional evaluation of its outputs. A process is automatic if it has (due to genetic prewiring or due to routinization by practice - see Logan, 1988; Palmeri, 1997; Rickard, 1997, for possible models of such routinization) acquired the ability to run without monitoring. This notion of automaticity is used in the present commentary.

According to this definition, once a process has been automatized it can be performed automatically as part of the task requirements by being a component of a higher order processing scheme defined by the required task (see Vallacher & Wegner, 1987). Or, it can run in an autonomous mode, as happens in Stroop-like phenomena and in the Exclusion task in the process dissociation paradigm (Jacoby, 1991). Tzelgov (1997) pointed out that the defining condition for the automaticity of a process is that it can run in the autonomous mode. Consider, as an example, the color-word Stroop task, in which the subjects are required to report the color of ink of a word while ignoring its meaning. The most frequent finding is that the response latency in the incongruent condition (e.g., "RED" written in blue) is longer than in the congruent condition ("BLUE" written in blue) or in the neutral condition (a nonword written in blue). This phenomenon, known as the Stroop effect (Stroop 1935), is usually taken as an indication for the automaticity of the reading process, at least in the narrow sense of "automatic" as processing without monitoring.

The clearest indications of autonomous processing in Stroop-like phenomena are found when there is dimensional overlap between the relevant and the irrelevant dimension (Kornblum, Hasbroucq, & Osman, 1990). However, indications of (automatic) processing of irrelevant aspects of the stimulus appear also in the absence of dimensional overlap, as indicated by the fact that interference due to automatic reading of the irrelevant word is not constrained to color words (Klein, 1964).

To sum up, according to this analysis, Stroop-like phenomena, i.e., phenomena in which a process that is not part of a task requirement affects behavior, are indications for the automaticity of that process. These indications are indirect because the process in question in not part of the task requirement (e.g., in the color-word Stroop task people are not asked to report the meaning of the word, they are asked to ignore it and to name the ink color). The automatic activity (reading in the color word Stroop task) is indicated by its effect on the intended activity (color naming). It should also be clear that in experiments in which attempts were made to directly measure the outcomes of automatic processing (e.g., subjects were asked to report the meaning of the word in addition to reporting its color) subjects frequently failed to provide indications of processing, and thus it has been suggested that people are not aware of the outcomes of such processing (Marcel, 1983, but see Holender, 1986).

4. Inattention Paradigm as Reflecting Automatic Processing of the Critical Stimulus

Automatic processing defined as processing without monitoring is best indicated in the autonomous mode when the process in question is not part of the task requirements. Therefore, Stroop-like phenomena provide indications of automaticity. I wish to argue that perceiving the target stimulus in the inattention paradigm is analogous to automatic processing of the irrelevant aspect(s) of the stimulus in Stroop-like phenomena, such as reading the word in the picture-word Stroop-like task (e.g., Smith & Kirsner, 1982) in which the automaticity of reading is evident without dimensional overlap.

Consider once again the inattention paradigm. Subjects are performing a specific task (deciding which arm of the cross is longer). The focus of their attention is on a region in space or on the "object" in space in terms of Logan's (1996) CTVA theory. Within the focus of spatial attention the critical stimulus appears in one of the trials. Its processing *is not part of the task requirements.* The phenomenon of attentional blindness is defined in terms of a *direct measure.* Thus, asking the subject if he/she had seen something besides the cross results in a significant portion of cases in which there was no indication that the critical stimulus is processed. The use of direct measures in the inattention paradigm is analogous to asking the subjects in the Stroop task to report the word of the stimulus after responding to its color (Marcel, 1983; Tzelgov, Porat, & Henik, 1997). Thus, inattentional blindness is parallel to subjects' limited ability to report the word in the Stroop task.

The experiments of Moore and Egeth (1997) demonstrated an experimental paradigm in the perceptual domain which parallels the Stroop paradigm in terms of using an indirect measure of automatic processing: they asked subjects to decide which of two presented lines was longer. In some of the trials dots in the background were random, in other trials the dots were grouped in specific ways that induced the Ponzo or the Muller-Lyer illusions. This induction of the illusions is an indication of automatic processing of the irrelevant background. Please notice that this indication is based on an indirect measure. In parallel, the subjects were not able to report which display occurred, once again showing the limitation of direct measures of automatic processing.

Mack and Rock (1998) considered the Moore and Egeth (1997) experiments as "modeled on" their inattentional blindness paradigm. Furthermore, in additional experiments of Mack and Rock the analogy between the inattention paradigm and Stroop-like task is complete; when the target stimulus was a word it affected stem completion and induced lexical and semantic priming. Thus to sum up, it seems that that the inattention paradigm, similar to Stroop-like tasks and the Exclusion task, reflects automatic processing in the autonomous mode.

5. Conclusions and Implications

It seems that the inattention paradigm as applied by Mack and Rock (1998) and by Moore and Egeth (1997) presents an example of autonomous automatic processing in the perceptual domain. Thus, the findings referring to indirect measures reported by Mack and Rock, as well as those of Moore and Egeth, provide indications for automaticity as processing without monitoring of perceptual information. At the center of interest of Mack and Rock are direct measures. The very limited reliability of direct measures of automatic processing, in general, and of autonomous automatic processing, in particular, leads to an interpretation of inattentional blindness in the inattention paradigm.

The "inattentionally blind" subjects in the inattention paradigm are blind to the critical stimulus in the same sense that subjects in the Stroop task are blind to the meaning of the presented words. In both cases blindness reflects the limitations of the representations resulting from automatic processing. While there is still an ongoing argument whether participants of Stroop experiments are aware of the words presented (see Marcel, 1983 and Tzelgov, Porat, & Henik, 1997, for contrasting findings), there is an agreement that nonautomatic and automatic processing result in different representations (Dulany, 1991; 1996; Tzelgov, 1997). One way to look at this difference is in terms of Logan and Zbrodoff's (1999) analysis of attention as aimed to support thought and language. According to their analysis, attention results in mapping from perceptual to cognitive (propositional) representations but this applies only to the attended aspects of the perceived situation. Thus, if some aspects of the perceived event are unattended, in the sense of not being selected for intentional processing, their representation will be perceptual rather than propositional and thus, less available to direct measures, i.e., verbal reports. Tzelgov, Ganor and Yehene (1999) analyzed the products of automatic processing within the framework proposed by Dienes and Perner (1999). Their analysis emphasizes that automatic processing results in a representation that is only partly explicit, which once again, leads to the conclusion of such products being less available to verbal reports.

According to the present analysis, the critical stimuli in the inattention paradigm are processed without attention in the (narrow) sense of not being selected for intentional processing. This is always true in the case of automatic processing. In the case of the Stroop task, when such processing is autonomous, it is the color that is intentionally selected for processing. In the case of processing the words of a sentence read for meaning, when automatic processing is "intentional", the sentence is intentionally selected and in this sense, attended (and monitored). In typical experiments of the inattention paradigm this is also the case. Under these conditions automatic processing is indicated by indirect measures, even in the case of subjects being "attentionally blind". However, since the critical stimulus is part of the spatially attended region, it is within the attentional spotlight. This may be one reason why when the critical stimulus is of ecological significance (e.g., one's name) attentional blindness is reduced. Logan and Zbrodoff (1999) pointed out that selective attention (on which Mack and Rock focus) results in propositional representations, which are more available for verbal reports. But it seems reasonable to assume that stimuli of ecological significance are mapped onto propositional representations even when they are not intentionally selected, in particular, when they are within the spatial attentional spotlight.

Mack and Rock (1998) use the term "inattentional blindness" because they define attention as a "process that brings a stimulus into consciousness" (p.26) and by consciousness they mean availability to report verbally. But we are conscious of many aspects of the external stimulation even if we are not able to report them verbally. This mode of consciousness is based on perceptual representations (Logan & Zbrodoff, 1999) of the stimuli perceived, provides the "feeling of" (Dulany, 1991) the stimuli and supports the indirect indications that the stimuli have been perceived. This notion of consciousness applies in particular to stimuli within the spatial attentional spotlight that were not selected for intentional processing. Those are the stimuli that the participants are "blind to" in the Mack and Rock experiments. Therefore, if the term attention aims to encompass spatial attention also, then describing Mack and Rock's data as reflecting automatic perceptual processing rather than "blindness" without attention, should be considered a serious alternative.

References

Carr, T. H. (1992). Automaticity and cognitive anatomy: Is word recognition automatic. *American Journal of Psychology, 105,* 237-201.

Dienes, Z., & Perner, J. (1999). A theory of implicit and explicit knowledge. *Behavioral and Brain Sciences, 22,* 735-808.

Dulany, D. (1991). Conscious representation and thought systems. In R. S. Wyer, & T. K. Srull (Eds.), *Advances in social cognition* (pp. 91-120). Hillsdale, NJ: Erlbaum.

Dulany, D. (1996). Consciousness in the explicit (deliberate) and the implicit (evocative). In J. Cohen, & J. Schooler (Eds.), *Scientific approaches to consciousness* (pp. 179-212). Hillsdale, NJ: Erlbaum.

Hasher, L., & Zacks, R. (1979). Automatic and effortful processes in memory. *Journal of Experimental Psychology: General, 108,* 356-388.

Holender, D. (1986). Semantic activation without conscious identification in dichotic listening, parafoveal vision, and visual masking: A survey and appraisal. *Behavioral and Brain Sciences, 9,* 1-66.

Jacoby, L. (1991). A process discrimination framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language, 30,* 531-541.

Klein, G. (1964). Semantic power measured through the interference of words with color-naming. *American Journal of Psychology, 77,* 576-588.

Kornblum, S., Hasbroucq, T., & Osman, A. (1990). Dimensional overlap: Cognitive basis for stimulus-response compatibility - a model and taxonomy. *Psychological Review, 97,* 253-270.

Logan, G. (1996). The CODE theory of visual attention: An integration of space based and object based attention. *Psychological Review, 103,* 603-649.

Logan, G., & Zbrodoff, N. (1999). Selection for Cognition: Cognitive constrains on visual attention. *Visual Cognition, 6,* 55-81.

Mack, A., & Rock, I. (1998). *Inattentional Blindness.* Cambridge, MA: MIT Press.

Marcel, A. (1983). Conscious and unconscious perception: Experiments in visual masking and work recognition. *Cognitive Psychology, 15,* 197-237.

Moore, C., & Egeth, H. (1997). Perception without attention: Evidence of grouping under conditions of inattention. *Journal of Experimental Psychology: Human Perception and Performance, 23,* 339-352.

Neisser, U. (1967). *Cognitive Psychology.* New York: Appleton Century Croft.

Neumann, O. (1984). Automatic processing: A Review of recent findings and a plea for an old theory. In W. Prinz, & A. F. Sanders (Eds.), *Cognition and automatic processing* (pp. 255-293). Berlin: Springer-Verlag.

Pashler, H. (1998). *The psychology of attention.* Cambridge, MA: MIT Press.

Posner, M. (1978). *Chronometric explorations of mind.* Hillsdale, NJ: Erlbaum.

Posner, M. (1980). Orienting of attention. *Quarterly Journal of Experimental Psychology, 32,* 3-25.

Smith, M., & Kirsner, K. (1982). Language and orthography as irrelevant features in color-word and picture-word Stroop interference. *Quarterly Journal of Experimental Psychology, 34A,* 153-170.

Treisman, A., & Gormican, S. (1988). Feature analysis in early vision: Evidence from search asymmetries. *Psychological Review, 95,* 14-48.

Tzelgov, J. (1997). Specifying the relations between automaticity and consciousness: A theoretical note. *Consciousness and Cognition, 6,* 441-451.

Tzelgov, J., Ganor, D., & Yehene, V. (1999). Automatic processing results in conscious representations. *Behavioral and Brain Sciences, 22,* 786-787.

Tzelgov, J., Porat, Z., & Henik. A. (1997). Automaticity and consciousness: Is perceiving the word necessary for reading it? *American Journal of Psychology, 110,* 429-448.

Vallacher, R., & Wegner, D. (1987). What do people think they are doing? Action identification and human behavior. *Psychological Review, 94,* 3-15.