

## Research Article

# Reward Priority of Visual Target Singletons Modulates Event-Related Potential Signatures of Attentional Selection

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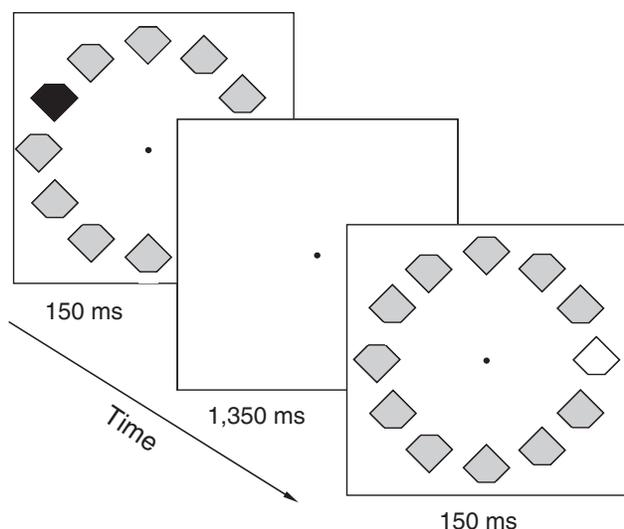
**ABSTRACT**—We examined visual search for color singleton targets, whose shape was discriminated. Critically, we varied the reward priority of singleton colors (correct fast performance was worth more bonus points for red singletons than for green singletons, or vice versa) to test whether event-related potential signatures of visual selection can be affected by distinct reward priorities for different target types, even when every target has to be selected for report. The N2pc component was earlier and larger for high- than for low-reward targets. This influence of reward on the N2pc correlated with the subject-by-subject impact of reward level on efficiency of behavioral performance. Later postselection processing was also affected by reward level. These results demonstrate that visual selection of task-relevant items is rapidly modulated by reward-related priorities, even when every target has to be selected for response.

Visual processing does not depend solely on current retinal inputs, but is known to be modulated also by attentional factors (i.e., task-relevant vs. task-irrelevant status of competing inputs) and by emotional factors (i.e., affective or reward-related status of those inputs), which might be conceived broadly as reflecting “cold” and “hot” aspects of cognition, respectively

(for a review, see Vuilleumier & Driver, 2007). Numerous functional neuroimaging and event-related potential (ERP) studies have now documented attentional (task-relevance) influences on visual processing (for reviews, see, e.g., Kastner & Ungerleider, 2000; Luck, Woodman, & Vogel, 2000). Other studies have analogously documented some affective influences on visual processing (e.g., Eimer & Kiss, 2007; Lane, Chua, & Dolan, 1999; Phelps & LeDoux, 2005; Surguladze et al., 2003; Vuilleumier & Pourtois, 2007). Such findings raise several new questions about how attentional modulation of visual processing may relate to more affective influences (see Vuilleumier & Driver, 2007).

In the study reported here, we examined a visual-search paradigm that is now particularly well characterized in relation to attentional influences (or putatively cold cognition; cf. Teasdale, 1993). We studied possible hot-cognition, reward-related influences in this paradigm, which has not been done before, to our knowledge. The basic paradigm involved search for a target singleton that had a unique color within each display (i.e., red among gray or green among gray; see Fig. 1), and might thereby attract attention automatically (e.g., Theeuwes, 1991). As in several previous behavioral and ERP studies (e.g., Bravo & Nakayama, 1992; Mazza, Turatto, Umiltà, & Eimer, 2007), our participants had to judge the location of a notch (in this case, at the top or bottom) in the singleton target on each trial (see also Kristjánsson, Vuilleumier, Malhotra, Husain, & Driver, 2005; Kristjánsson, Vuilleumier, Schwartz, Macaluso, & Driver, 2007). Our novel manipulation was that we varied the reward level of red singletons relative to green. For some participants,

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**Fig. 1.** Illustration of two successive trials of the search task. In each brief display, the target was the uniquely colored singleton (unpredictably either red or green) presented among gray nontargets, and participants had to indicate whether the small notch on the target was at its top or bottom. All nontargets also had notches, randomly at the top or bottom, regardless of the notch position for the target. The singleton target in each display had to be selected for judgment and speeded accurate response, but we varied reward level of the two target colors; fast correct responses to targets in the high-reward color received 5 bonus points, whereas fast correct responses to targets in the low-reward color received only 1 bonus point. The assignment of colors to reward levels was counterbalanced across participants. In the figure, one target color is shown in black, and the other in white.

correct fast performance was worth more “bonus points” (see the Method section) for red targets than for green targets; for other participants, the relative reward value for red and green targets was reversed, in a counterbalanced manner. Thus, we could examine how reward-related priorities might influence performance in this visual-search task. We also acquired electroencephalographic (EEG) data, which allowed us to determine, for the first time, whether manipulation of reward-related priorities in a well-understood visual-search paradigm would influence ERP signatures related to visual selection, and if so, at which time points and for which components.

A sizable ERP literature has already studied singleton visual search (e.g., Eimer & Kiss, 2008; Hickey, McDonald, & Theeuwes, 2006; Kiss, Jolicœur, Dell’Acqua, & Eimer, 2008; Luck & Hillyard, 1994a, 1994b; Schubö, Schröger, Meinecke, & Müller, 2007), but without considering possible reward-related influences. Such work has identified the N2pc component as an important correlate of visual target selection. The N2pc is an enhanced negativity at posterior electrodes contralateral to a target within an array of multiple items. It typically emerges approximately 180 to 220 ms after display onset and is thought to reflect attentional selection of a target item from among distractors (typically, selection of the item as needing to be judged and reported; e.g., Luck & Hillyard, 1994a, 1994b; see also Eimer, 1996; Girelli & Luck, 1997; Woodman & Luck, 1999).

Brain source analyses based on magnetoencephalographic recordings have implicated extrastriate visual cortex in the N2pc induced by task-relevant items; there may also be some contribution from posterior parietal cortex in the earliest phase of this component (e.g., Hopf et al., 2000). As an on-line electrophysiological marker, the N2pc can be used as a tool to study the time course of attentional selection during visual search (e.g., Woodman & Luck, 1999, 2003).

A later ERP component, again lateralized with respect to a target item appearing among nontargets, has also been reported (Vogel & Machizawa, 2004; see also Dell’Acqua, Sessa, Jolicœur, & Robitaille, 2006; Mazza et al., 2007; McCollough, Machizawa, & Vogel, 2007). This sustained posterior contralateral negativity (SPCN) typically arises approximately 350 to 400 ms after display onset and is thought to reflect additional processing of target stimuli after their attentional selection, including their maintenance in visual short-term memory.

We examined whether the N2pc, SPCN, or both would be affected by our novel manipulation of reward level for different types of singleton targets in the visual-search task (see Fig. 1). Because both the red and the green color singletons were salient target stimuli that had to be selected, judged, and responded to, both types of targets were expected to elicit an N2pc. In terms of bottom-up physical salience, as opposed to reward level, they were equated not only via equiluminance, but also via full counterbalancing of the two colors with respect to reward level. Thus, in terms of traditional cold-cognition factors, both types of targets had to be selected and responded to, and the two types were fully equivalent (after counterbalancing) in their physical features. They differed only in their reward level, and thus any reward-related prioritization they might receive. If selection of salient color singletons, as reflected by the N2pc component, is determined exclusively by physical salience or the requirement to be explicitly judged, this component should be equivalent regardless of reward level for the two target types we included. However, if the rapid selection process that the N2pc signifies can be sensitive to reward-related prioritization, a faster or increased N2pc would be expected specifically for high-reward targets, despite their equivalence to the alternative target type in all other respects. Similar arguments apply for postperceptual encoding of target stimuli into visual short-term memory, as reflected by the SPCN component. Finally, to look for reward-related brain-behavior relationships, we tested for subject-by-subject correlations between the impact of reward level on behavior and on the N2pc (or SPCN).

## METHOD

### Participants

Eighteen paid volunteers participated; 3 were excluded because of excessive eye movements, and 1 was excluded because of exceptionally slow responses to one target type (see Stimuli and Procedure). Thus, 14 participants (6 male, 8 female; mean age =

26.9 years) remained in the sample. Two were left-handed, and all reported normal or corrected visual acuity. All participants gave informed consent in accord with local ethics, received a bonus payment of £5 (see Stimuli and Procedure), and were fully debriefed at the end of the experiment.

### Stimuli and Procedure

Stimuli were presented on a 17-in. computer monitor at a viewing distance of 60 cm. A central gray fixation point ( $0.3^\circ \times 0.3^\circ$  visual angle) was present throughout. On each trial, a circular array of 12 diamonds, each with a notch at the top or bottom (see Fig. 1), was presented against a black background. Each diamond was  $4^\circ$  from the fixation point and subtended  $1^\circ \times 1^\circ$  (disregarding the  $0.35^\circ$  notch, which was randomly positioned at the top or bottom). Each array contained 11 gray distractor diamonds and 1 uniquely colored (singleton) target diamond, which was red on half the trials and green on the others. The color of the target diamond was unpredictable. The gray, red, and green diamonds were physically equiluminant ( $14.1 \text{ cd/m}^2$ ). The red and green target singletons appeared equiprobably at all the positions around the circular array except the top or bottom (because the critical ERP contrasts relied on the hemifield of the singleton target—see EEG Data Acquisition and Analysis). Each search array was presented for 150 ms (an interval that was too brief for saccades and therefore further encouraged central fixation). The interval between the onset of successive search displays was 1,500 ms. The experiment comprised 16 blocks of 40 trials each, plus 1 initial practice block that was not analyzed.

Participants were instructed to report whether the notch on each singleton target was at its top or bottom by pressing a spatially analogous key (i.e., one key was located above the other) with the left or right index finger. Assignment of hands to response keys was reversed after half of the blocks, with the order of that assignment counterbalanced across subjects. Hence, overall, the responding hand was not a critical factor. Our critical manipulation concerned the reward level of red and green singleton targets. Before the task, participants were informed that they could earn a bonus payment by accumulating a sufficient number of bonus points for fast and correct responses. (In fact, our local ethics committee required that all participants receive the same £5 bonus payment on completion of the study, which they all did.) Participants were told that 5 bonus points could be earned for a correct fast response to any target in the high-reward color, and 1 bonus point could be earned for a correct fast response to any target in the other color. For half of the participants, the high-reward color was red; for the other half, it was green. After each block, participants received feedback on the total number of bonus points earned in that block. They were encouraged to aim for a score of at least 60 bonus points per block. In each block, bonus points were awarded for trials with both a correct response and a reaction

time (RT) faster than the median RT of all correct responses in that block.

This scoring system motivated participants to aim for accuracy as well as speed (because no bonus points were ever awarded for incorrect responses). To detect any participants who adopted a strategy of deliberately delaying correct responses to low-reward targets (to increase the likelihood of collecting bonus points for responses to high-reward targets), we examined the full RT distributions for all subjects, and found only 1 with substantial outliers—exceptionally slow RTs specifically for the low-reward targets. This participant was excluded from analyses. During the debriefing, no other participants reported using a go-slow strategy on low-reward trials. To ensure further that faster responses to high-reward than to low-reward targets were not due to a speed-accuracy trade-off, we analyzed all our behavioral results using the well-established measure of inverse efficiency (e.g., Kennett, Eimer, Spence, & Driver, 2001; Townsend & Ashby, 1983), which is calculated separately for each participant as mean correct RT divided by the proportion of correct responses. Hence, both speed and accuracy were always taken into account when considering behavioral performance.

### EEG Data Acquisition and Analysis

EEG was recorded from 23 Ag-AgCl electrodes mounted in an elastic cap at standard positions according to the 10/20 system. Horizontal eye movements were measured from two electrodes placed at the outer canthi of the eyes. The amplifier band pass was 0 through 40 Hz, with a 250-Hz sampling rate. Scalp electrodes were referenced to the left earlobe during recording. The right earlobe was recorded as an additional channel, and all channels were rereferenced off-line to averaged earlobes. All electrode impedances were kept below 5 k $\Omega$ . Continuous EEG was segmented from 100 ms before stimulus onset to 500 ms poststimulus. Epochs containing horizontal eye movements (horizontal electro-oculogram signal exceeding  $\pm 25 \mu\text{V}$ ), eye blinks (voltage at frontopolar electrode Fpz exceeding  $\pm 60 \mu\text{V}$ ), or movement artifacts (EEG signal exceeding  $\pm 80 \mu\text{V}$  at any of the other electrodes) were eliminated from further analyses. Only EEG from trials with a correct behavioral response was analyzed.

EEG waveforms were averaged separately for each combination of reward level (high-reward color or low-reward color) and target position (left or right hemifield). N2pc and SPCN components were measured at lateral posterior electrodes PO7/8, where their amplitudes were maximal (see also McCollough et al., 2007). Mean amplitude values were computed within two post-stimulus-onset time windows. One corresponded to the early portion of the N2pc component (180–230 ms), which reflects rapid attentional selection (e.g., Eimer & Kiss, 2008); the other covered the interval (360–500 ms) during which the SPCN was present in previous research in our lab using a similar

paradigm, albeit without the critical reward manipulation introduced here (Mazza et al., 2007).

We examined mean amplitudes using repeated measures analyses of variance (ANOVAs) with the factors of reward level (high or low), contralaterality (electrode site ipsilateral or contralateral to the target's location), and target side (left or right hemifield). Onset latency of the N2pc was determined as the time point at which the voltage value on the ascending flank of individual N2pc difference waveforms exceeded an a priori criterion of  $-1.0 \mu\text{V}$  (though alternative approaches to defining N2pc onset gave the same results; see the next section). Effect sizes were calculated as the standardized mean difference,  $d$ , when  $t$  tests were used. With ANOVAs, we used partial eta-squared ( $\eta_p^2$ ) as our measure of effect size, to estimate the proportion of total variance that can be attributed to one factor, partialing out other factors from the total nonerror variance. For all statistical tests, we report the probability of replicating an effect in the same direction ( $p_{\text{rep}}$ ), rather than the traditional  $p$  value;  $p_{\text{rep}}$  values of .9 and above correspond to significant  $p$  values (see Killeen, 2005).

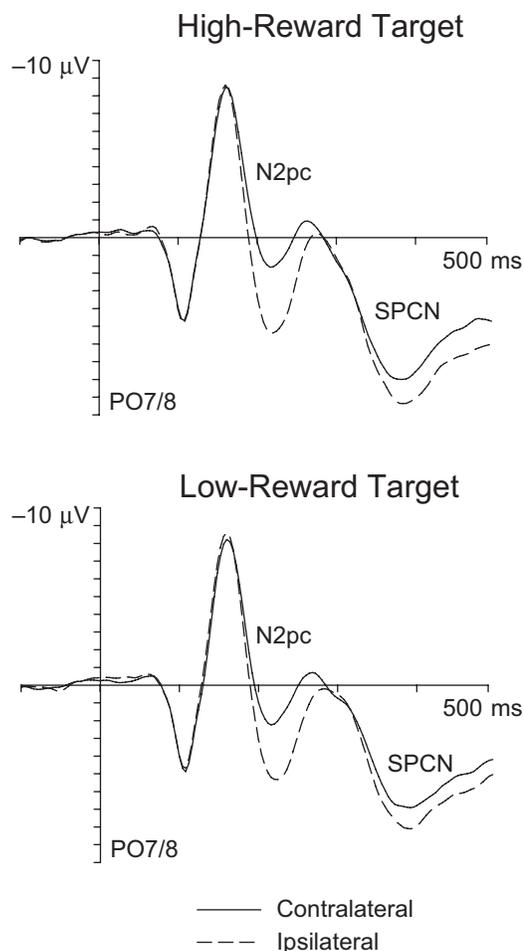
## RESULTS

### Behavioral Data

RTs from error trials and RTs more than 3 standard deviations from the mean RT, calculated separately for each reward level and participant, were excluded. The speed criterion eliminated only 1% of correct trials, and there was no difference between high- and low-reward targets in the exclusion rate. Across participants, RTs to high-reward targets were faster than RTs to low-reward targets (group means of 490 vs. 508 ms),  $t(13) = 4.8$ ,  $p_{\text{rep}} = .99$ ,  $d = 1.3$ . Error rates were 5.7% and 4.9% for high- and low-reward targets, respectively,  $t(13) = 1.2$ ,  $p_{\text{rep}} = .37$ ,  $d = -0.33$ . As already mentioned, to guard against possible speed-accuracy trade-offs, we combined RT and error rates for each participant into the single parameter of inverse efficiency (Townsend & Ashby, 1983), calculated as the mean correct RT divided by the proportion of correct responses. This measure was calculated separately for each condition. Inverse efficiency was lower (i.e., performance was more efficient) for high-reward than for low-reward targets (525 vs. 539 ms),  $t(13) = 3.7$ ,  $p_{\text{rep}} = .99$ ,  $d = 1.0$ .

### ERP Data

Figure 2 shows ERP waveforms elicited at PO7/8 for high-reward and low-reward target singletons. The N2pc component (enhanced negativity contralateral to the target) for the high-reward target appears to be slightly larger and earlier than the N2pc for the low-reward target. The subsequent SPCN component also seems more pronounced for the high-reward target. These effects can be seen more clearly in the difference waveforms shown in Figure 3, which were obtained by subtracting

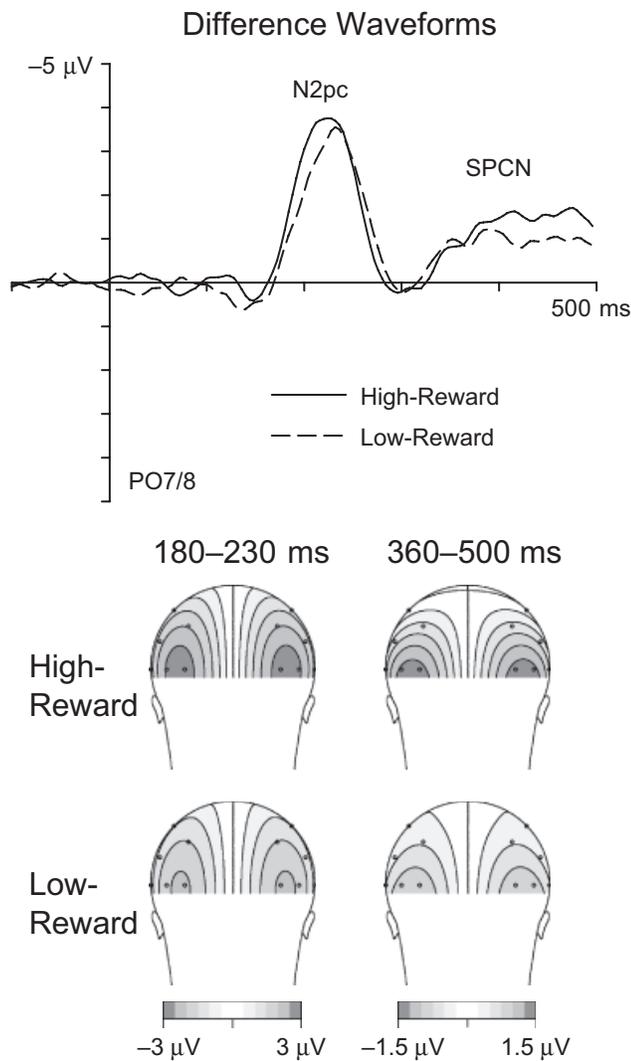


**Fig. 2.** Grand-average event-related potentials (ERPs) elicited at lateral posterior electrode sites (PO7/8) for search arrays containing a high-reward singleton (top panel) and for search arrays containing a low-reward singleton (bottom panel). Separate waveforms are shown for electrodes contralateral and ipsilateral to the target. Note that high- and low-reward targets were physically equivalent, as assignment of colors to reward levels was counterbalanced across participants. The two ERP components of particular interest (N2pc and sustained posterior contralateral negativity, or SPCN) are labeled.

ipsilateral from contralateral ERPs, separately for high- and low-reward targets. Statistical analyses confirmed these effects.

### N2pc (180–230 Ms Poststimulus)

In the N2pc time window, a main effect of contralaterality,  $F(1, 13) = 18.3$ ,  $p_{\text{rep}} = .99$ ,  $\eta_p^2 = .584$ , confirmed that an N2pc was elicited in response to the color singleton targets at PO7/8, as expected. Indeed, the N2pc was present for both high-reward targets,  $F(1, 13) = 20.2$ ,  $p_{\text{rep}} = .99$ ,  $\eta_p^2 = .608$ , and low-reward targets,  $F(1, 13) = 14.6$ ,  $p_{\text{rep}} = .99$ ,  $\eta_p^2 = .529$ . But most important, there was a Reward Level  $\times$  Contralaterality interaction,  $F(1, 13) = 6.7$ ,  $p_{\text{rep}} = .95$ ,  $\eta_p^2 = .341$ , because N2pc amplitudes were larger for high- than for low-reward targets. Moreover, the onset of the N2pc (as defined by our a priori criterion of  $-1.0 \mu\text{V}$ ) was earlier for high- than for low-reward targets (187 vs. 195 ms, respectively),  $t(13) = 2.2$ ,  $p_{\text{rep}} = .92$ ,



**Fig. 3.** Event-related potential (ERP) difference waveforms (contralateral minus ipsilateral) from electrodes PO7/8 and their scalp topography. Results are shown separately for high-reward and low-reward targets. The topography of the difference waveform for the N2pc (180–230 ms) is shown at the bottom left, and the topography of the difference waveform for the sustained posterior contralateral negativity (SPCN; 360–500 ms) is shown at the bottom right. Note the different scales used for these two components in the topographic maps. The difference waveforms shown here were derived from the separate contralateral and ipsilateral waveforms shown in Figure 2.

$d = 0.52$ . The earlier onset of the N2pc for high- than for low-reward targets was also confirmed when onset was defined instead as 50% of the peak amplitude, measured separately for each participant,  $t(13) = 2.5, p_{\text{rep}} = .94, d = 0.80$ .

The topographical maps in Figure 3 show that the scalp distribution of the N2pc component was very similar for high- and low-reward targets. To confirm that effects of reward level on N2pc amplitudes and onset latencies were not restricted to electrodes PO7/8, we conducted additional analyses that included all three lateral posterior electrode pairs (PO7/8, P7/8, and P3/4); electrode site was an additional factor in these analyses. A Reward Level  $\times$  Contralaterality interaction,  $F(1,$

13) = 6.0,  $p_{\text{rep}} = .94, \eta_p^2 = .315$ , indicated that N2pc amplitudes were generally larger for high-reward targets than for low-reward targets. There was also an Electrode Site  $\times$  Reward Level  $\times$  Contralaterality interaction,  $F(1, 13) = 3.2, p_{\text{rep}} = .90, \eta_p^2 = .196$ , as the effect of reward level was largest at PO7/8. However, analyses conducted separately for P7/8 and P3/4 revealed a Reward Level  $\times$  Contralaterality interaction for each of these electrode pairs also,  $F_s(1, 13) = 4.9$  and  $5.8, p_{\text{rep}s} = .92$  and  $.94, \eta_p^2_s = .275$  and  $.307$ , respectively. N2pc onset (defined by the  $-1.0\text{-}\mu\text{V}$  criterion) was earlier for high- than for low-reward targets across all three posterior electrode pairs (190 vs. 197 ms), as demonstrated by a main effect of reward level,  $F(1, 13) = 3.7, p_{\text{rep}} = .90, \eta_p^2 = .223$ ; there was no Electrode Site  $\times$  Reward Level interaction ( $F < 1$ ).

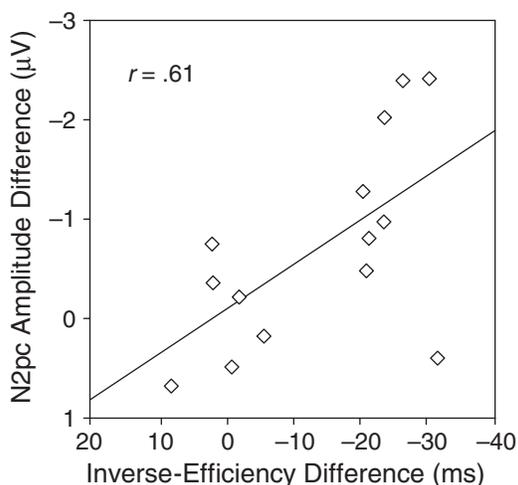
In summary, the N2pc emerged earlier and had a larger amplitude for high- than for low-reward targets, despite their perfectly equated (fully counterbalanced) physical salience, and despite the fact that targets of both types had to be selected, judged, and responded to, and provided an opportunity to earn bonus points. Therefore, the differential pattern of results for N2pc latency and amplitude can reflect only the reward-level manipulation.

#### SPCN (360–500 Ms Poststimulus)

The presence of the SPCN component was confirmed by a main effect of contralaterality during the later time window,  $F(1, 13) = 9.3, p_{\text{rep}} = .97, \eta_p^2 = .418$ . This component was present for high-reward targets,  $F(1, 13) = 11.9, p_{\text{rep}} = .98, \eta_p^2 = .477$ , as well as for low-reward targets,  $F(1, 13) = 6.2, p_{\text{rep}} = .94, \eta_p^2 = .322$ . As did the N2pc, the SPCN showed an interaction between reward level and contralaterality,  $F(1, 13) = 6.6, p_{\text{rep}} = .95, \eta_p^2 = .337$ , as a result of an enhanced SPCN for high-reward targets (see Figs. 2 and 3). In addition, there was a main effect of reward level,  $F(1, 13) = 4.9, p_{\text{rep}} = .92, \eta_p^2 = .273$ , with ERPs generally being more positive for high-reward trials than for low-reward trials during the 360- to 500-ms time window (see Fig. 2). The scalp topography of the SPCN (as shown in Fig. 3) was comparable for high- and low-reward targets, with just its amplitude being enhanced for high-reward targets.

#### Brain-Behavior Relations in the Impact of Reward

To explore any relationship between enhanced behavioral efficiency and enhanced amplitudes of the lateralized ERP components for high- versus low-reward targets, we calculated Pearson correlations (and also Spearman nonparametric rank correlations, to minimize any influence from outliers) between the subject-by-subject size of the behavioral effect of reward level on inverse efficiency (the most informative behavioral measure, which combines RT and accuracy) and the subject-by-subject size of the effect of reward level on N2pc and SPCN amplitudes at PO7/8. This analysis revealed that the effect of reward level on performance was positively correlated with the



**Fig. 4.** Scatter plot illustrating the relationship (across participants) between the effects of reward level on inverse efficiency and on N2pc amplitudes at P07/8. The difference in N2pc amplitude between high- and low-reward targets is plotted as a function of the difference in inverse efficiency between high- and low-reward targets. Negative values indicate better behavioral performance and larger N2pc components for high-reward targets.

effect of reward level on N2pc amplitude (see Fig. 4),  $r(12) = .61$ ,  $p_{\text{rep}} = .95$ ;  $r_s(12) = .57$ ,  $p_{\text{rep}} = .94$ . There were similar but less reliable trends for an analogous relationship between the effect of reward level on performance and the effect of reward level on SPCN amplitude,  $r(12) = .43$ ,  $p_{\text{rep}} = .86$ ;  $r_s(12) = .43$ ,  $p_{\text{rep}} = .86$ .

## DISCUSSION

Processing of visual stimuli can be modulated by task relevance and by affective significance (see Vuilleumier & Driver, 2007, for a recent review), but, as yet, relatively little is known about the interplay between such aspects of cognition in visual selection. Moreover, putatively hot, reward-related aspects have rarely been considered in the work on visual search. We used electrophysiological markers of target selection (N2pc) and of postselection processing (SPCN) to demonstrate for the first time that the reward level of targets can have systematic, and remarkably early, effects on visual selection in a singleton-search task. The N2pc component emerged earlier and was larger in amplitude for high- than for low-reward targets. This finding demonstrates that reward value can affect the efficiency of target selection within the first 200 ms of processing after stimulus onset. Moreover, the size of the effect on N2pc amplitude correlated positively with the impact of reward level on performance efficiency.

These rapid influences of reward level are all the more remarkable when one considers that all of our target stimuli were color singletons, which are often assumed to attract attention in a rapid, bottom-up fashion because of high perceptual salience (e.g., Theeuwes, 1991). Some previous behavioral research (e.g.,

Folk, Remington, & Johnston, 1992) has shown that attentional capture by color singletons can be contingent on task set. Combined, our behavioral and electrophysiological findings reveal that selection of color singletons can also be modulated by their reward status, potentially indicating another important source of top-down influence. A recent study by Della Libera and Chelazzi (2006) provided some initial evidence for effects of reward on attentional processing: Negative priming effects (i.e., delayed responses to targets that served as distractors on the preceding trial) were observed after the selection of targets that received a high monetary reward, but not after target selections that were poorly rewarded. Thus, attentional inhibition of distractors may be sensitive to reward contingencies. Whereas those findings show that reward can affect the later consequences of selective attentional processing, our results demonstrate that the speed and efficiency with which targets are selected can be modulated by their reward status. It might be argued that our manipulation of reward level affected participants' motivation, prioritization of the target types, or allocation of attentional effort to one target type versus the other. But this would not undermine our main conclusion that targets' reward level can lead to modulations of attentional selection that arise remarkably rapidly after display onset. Indeed, attentional effort might provide one bridge between putatively hot (reward-related) and putatively cold (report-related) aspects of selective cognition, allowing reward-related priorities to modulate attentional performance.

Our further observation that SPCN amplitudes were larger for high- than for low-reward targets implies that the influences of reward on visual search may not be restricted to initial selection of targets, but can also extend to subsequent, more in-depth processing, and maintenance in visual short-term memory. Thus, reward-related influences on selective visual processing are evidently present both at relatively early stages of initial selection (as indicated by the N2pc) and during subsequent postselection processing (as indicated by the SPCN).

In conclusion, our study reveals that singleton visual search is influenced not only by bottom-up stimulus salience (as emphasized, e.g., by Theeuwes, 1991), and not only by relevance for report (see Folk et al., 1992), but also by the reward level of different target types. The influences of reward on visual search can evidently arise relatively early in target selection, and go on to affect later stages of selective processing as well. Although reward has previously been shown to influence many aspects of behavior in an instrumental fashion (e.g., see Dayan & Balleine, 2002, for a review), its possible impact on rapidly selective visual processing has been overlooked. Such an influence was clearly revealed in the present study, not only for behavioral performance, but also for electrophysiological markers of selective visual processing.

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