



The effects of private and collective self-priming on visual search: Taking advantage of organized contextual stimuli

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Two experiments tested the hypothesis that priming the collective self improves some visual search tasks. In both experiments, participants searched for an O among Qs. The pattern of distracters was manipulated across experiments to allow the possibility of grouping (Experiment 1) or to disallow this possibility (Experiment 2). Consistent with expectations, collective self-priming increased visual search speed when grouping was possible but it had no effect on visual search speed when grouping was not possible. In combination, the data support the notion that collective self-priming makes people more likely to utilize a pattern to facilitate visual search when there is a pattern present to be perceived.

According to cross-cultural researchers, self-construals are thoughts that have the ability to 'influence, and in many cases determine, the very nature of individual experience, including cognition, emotion, and motivation' (Markus & Kitayama, 1991, p. 159). Many of these researchers agree that there are two distinct types of self-construals: interdependent and independent which are also referred to as collectivistic and individualistic, respectively (Cousins, 1989; Fiske, Kitayama, Markus, & Nisbett, 1998; Ji, Peng, & Nisbett, 2000; Kitayama, Markus, & Kurokawa, 2000; Markus & Kitayama, 1991; Nisbett, 2003/2004; Nisbett & Masuda, 2006; Sussman & Rosenfeld, 1982; Triandis, 1989; Trafimow, Triandis, & Goto, 1991). Although there are two distinct types of self-construals, people do not fall into an 'either/or' category. In fact, all individualistic and collectivistic persons have both individualistic and collectivistic self-concepts. However, the relative accessibility of these self-concepts can be manipulated and thereby influence a multitude of different variables. One variable is a self-descriptor type where collectivistic participants describe themselves in terms of group membership and belongingness (e.g. 'I am a student') and individualistic participants describe themselves in terms of uniqueness and being

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separated from the surrounding context ('I am short') (Cousins, 1989; Kitayama, Markus, Mastumoto, & Norasakkunkit, 1997; Kitayama *et al.*, 2000).

Another variable of interest that is influenced by self-construals is in-group and out-group membership (Gomez, Kirkman, & Shapiro, 2000; Triandis, 2001). According to Triandis, many researchers have shown that collectivist people 'give priority to the goals of their in-groups (2001, p. 909)' whereas individualistic people give less priority to their in-groups (see Triandis, 2001, 1995 for a review). In addition to these findings, Gomez *et al.* (2000) demonstrated that in-group members are evaluated more positively by collectivists than individualists.

These types of self-construals have been shown to be highly influenced by culture (Fiske *et al.*, 1998; Ji *et al.*, 2000; Kitayama *et al.*, 2000; Markus & Kitayama, 1991; Nisbett, 2003/2004; Nisbett & Masuda, 2006), with Easterners being more interdependent than independent and Westerners being more independent than interdependent. Interestingly, these differences in culture have also been demonstrated to influence performance on visual tasks; Westerners appear to focus processing on isolated foreground objects whereas East Asians appear to focus processing on contextual information (Chua, Boland, & Nisbett, 2005; Ji *et al.*, 2000; Masuda & Nisbett, 2001; Miyamoto, Nisbett, & Masuda, 2006). However, these differences in performance on visual tasks, self-construals, and in-group preference are not influenced only by culture. In fact, every person, regardless of culture, has both collectivistic and individualistic self-construals and because of this, either self-construal can gain increased activation through the use of priming.

Private and collective self-priming

The ability to make self-construals cognitively accessible was discovered by Trafimow *et al.* (1991) with the development of the *two baskets theory*. This theory proposes that private (previously referred to as independent/individualistic) and collective (previously referred to as interdependent) thoughts about the self are stored in separate cognitive structures termed the private self and collective self, respectively. To test this theory, the authors primed the private and collective selves in Study 1 by having participants think about how they were different from or similar to their friends and family, respectively. In Study 2, they primed participants by having them read a story about a warrior who chose a commander for his army based on *personal glory* (private prime) or *family loyalty* (collective prime). Following the prime, participants then filled out the Kuhn and McPartland twenty statements test (TST; 1954), which required participants to answer 'Who am I?' by completing 20 'I am _____' statements.

According to the *two baskets theory*, it is possible to prime the private or the collective self and thereby increase the retrieval of private or collective self-cognitions, respectively. In support of this argument, participants who were primed with the private self had a greater number of individualistic/private responses (traits, states, behaviours) on the TST in comparison to participants who were primed with the collective self, whereas participants who were primed with the collective self had a greater number of group responses in comparison to participants who were primed with the private self.

Numerous studies have supported these findings with the use of various primes and dependent variables. Trafimow, Silverman, Fan, and Law (1997) and Kimmelmeir and Cheng (2004) demonstrated that the private and collective selves could be primed with the simple use of language as the independent variable. When bilingual Chinese participants listed self-cognitions in English, they retrieved more private self-cognitions than collective self-cognitions and when they listed self-cognitions in Chinese, they

retrieved more collective self-cognitions than private self-cognitions. Gardner, Gabriel, and Lee (1999) incorporated the private and collective self-priming technique developed by Trafimow *et al.* (1991) to show that the accessibility of private or collective self-cognitions could cause a shift in social values.

Ybarra and Trafimow (1998) also used the private and collective self to test their influence on two dependent variables: how much a person's intent to behave was based on their own personal feelings (attitudinal control) and how much a person's intent to behave was based on the feelings of important others (normative control). They found that people primed with the private self were more under attitudinal control than normative control and people primed with the collective self were more under normative control than attitudinal control. Overall, this research demonstrates that priming the private or collective self can influence the content of people's personal thoughts about individualism, group membership, social values, and behaviour.

Interestingly, the accessibility of the private and collective selves may not only affect personal thoughts, but also might also influence perceptual processing. A possible mechanism through which this type of influence occurs was presented by Kühnen, Hannover, and Schubert (2001) and termed the semantic-procedural interface (SPI) model. These researchers proposed that self-concepts accessible at the time would 'provide different procedural modes of thinking (p. 397)' such as thoughts about uniqueness when the private self is accessible and thoughts about relatedness when the collective self is accessible. Therefore, these researchers predicted that a person's current mode of thinking would influence the amount of focus that he/she places on contextual information. To test this model, Witkin's (1969) embedded figures test (EFT) and the Hamburg-Wechsler intelligence test (HAWIE-R; Tewes, 1994) were used. The EFT, which was used in Study 1, presents participants with the picture of a simple figure followed by the presentation of a complex figure. Embedded within the complex figure is the simple figure. For example, imagine that participants are presented with a triangle, known as the simple figure. Next, participants are presented with a picture of the triangle surrounded by multiple shapes attached to its edges. The attached multiple shapes are referred to as the context, or the background, that the triangle is embedded in. The task is to find the simple figure embedded in the complex figure, with response time (RT) serving as the dependent variable.

These researchers hypothesized that participants primed with the private self would use more context-independent perceptual processing, and thereby have decreased reaction times in finding the target (the simple figure) in comparison to collective self-primed participants. As expected, private self-primed participants were significantly faster than collective self-primed participants at finding the simple figure in two separate experiments.

However, the EFT is presented in such a way that the target figure is attached to the distracters surrounding it, making context-dependency a detriment. Kühnen *et al.* (2001) proposed the possibility that if a task was presented which made context-dependency a benefit, then collectively self-primed participants would outperform private self-primed participants. To test this possibility, Kühnen *et al.* (2001) presented collective and private self-primed participants with the HAWIE-R task. This task requires participants to look at a picture and tell the experimenter what detail the picture is lacking. For instance, if the picture is of a person standing next to a tree, some flowers, and a dog with the sun shining in the sky, and every object in the picture is throwing a shadow except the person, then the person's missing shadow would be the correct answer for that particular picture task. Interestingly, when this task was used instead of the EFT, the collective self-primed

participants performed better than the private self-primed participants. This finding demonstrated that when context dependency is beneficial, collective self-primed participants outperform private self-primed participants.

Although Kühnen *et al.* (2001) demonstrated a social cognition difference with the use of the EFT and HAWIE-R, these dependent variables only test a certain range of visual cognition. For example, in the EFT, the simple figure (the target) is always present within the presented complex figure (distracters) with which it is connected. This type of target search does not always occur in the real world. When driving down a busy street (Horrey, Wickens, & Consalus, 2006; Liu, 2005; Reimer & Sodhi, 2006; Wilson, Smith, Chattington, Ford, & Marple-Horvat, 2006) or navigating a cluttered computer interface (Michalski, Grobelny, & Karwowski, 2006; Pike, 2004; Zhang & Salvendy, 2001), the task is usually to find the target that is not connected to and/or separate from the non-target, or distracter, items. Furthermore, there are also real-world instances where the target is not even present. Although the HAWIE-R implements these types of target absent (TA) instances, it is a separate task altogether from the EFT. Furthermore, the HAWIE-R relies on recognizing missing elements that would usually be present in the real world instead of recognizing a missing target.

Therefore, an ideal instrument to assess perceptual differences between private and collective self-primed participants would be one that contains both target present (TP) and TA trials, allows for the manipulation of contextual information, and involves targets that are disconnected from their distracters. The visual search paradigm developed by Neisser (1963) implements these differences (Neisser, 1963; Treisman & Gelade, 1980). For instance, in a standard laboratory visual search task, the participant is asked to determine whether a designated target item is present among a set of distracter items, providing a present or absent judgment as rapidly as possible. Performance is then assessed by examining changes in response time (RT) that occur as the number of distracters (referred to as set size) varies (Wolfe, 1998).

These variations in accuracy and RT have provided a window into perceptual processing for cognitive scientists (e.g. Neisser, 1963; Treisman & Gelade, 1980). For instance, data are typically characterized by a linear function in which the intercept is taken to reflect the time needed for pre-attentive processing and later response-related processes, and slope is taken to reflect the efficiency with which attention is guided to the target object. The slope and intercept are obtained from a linear regression analysis of RTs on to set size (Wolfe, 1998). If the intercept does not differ between conditions, then one can preclude differences in pre-attentive processing and later response-related processes. The next logical step is to focus instead on differences in search strategies, which are indicated by variations in slope functions.

Pertaining to the slope, if search is effortless, added distracters will have little effect on the speed of performance, and the slope of the RT \times set size function will be shallow. Keeping with the previous example, an effortless search will reveal almost no increase in the slope between the 25 and 49 set sizes. However, if search is more difficult, added distracters will slow performance more dramatically, producing a steeper function. Research using the visual search task has converged on a two-stage model of performance in which coarse information encoded during early perceptual processing is used to guide movements of focused attention during later processing (Itti & Koch, 2000; Neisser, 1963; Treisman & Gelade, 1980; Treisman & Sate, 1990; Wolfe, 1994). In the first stage of search, feature detectors operating in parallel across the visual field extract an initial representation of the stimulus array. Stimulus properties registered at this stage, however, include only primitive features such as colour, size, orientation, and motion

(Wolfe, 1998), along with coarse aspects of shape (He & Nakayama, 1992; Wolfe & Bennett, 1997), 3-D spatial relationships (Enns & Rensink, 1990), and stimulus grouping (Duncan & Humphreys, 1989; Humphreys, Quinlan, & Riddoch, 1989; Treisman, 1982). In the second stage of processing, therefore, focused visual attention is employed to resolve more fine-grained stimulus characteristics, including detailed information about arrangements and conjunctions of primitive features (Treisman & Gelade, 1980; Wolfe & Bennett, 1997). A judgment that requires such detailed perceptual information can be made only after attention has narrowed on the target object.

Thus, if the target is distinguished by features encoded during parallel processing, it will be detected effortlessly, producing a shallow RT function as more distracters are included. Otherwise, serial search with focused attention will be demanded, and RT functions will increase more steeply as set size increases. Information encoded during parallel processing, though, can guide movements of focused attention towards potential target objects. The efficiency of search will therefore be determined by the ease with which parallel processing brings attention to the target object. In general, search will become more efficient when feature differences between the target and distracters become greater, or when perceptual grouping of distracter items becomes stronger (Duncan & Humphreys, 1989; Humphreys *et al.*, 1989).

On trials on which no target is discovered, finally, search will continue until the observer reaches a decision to terminate attentional scanning and execute a TA response (Chun & Wolfe, 1996). The amount of effort invested in search before a TA response is issued is determined by the searcher's stopping policy; the observer may scan cursorily and terminate search quickly, producing very short TA RTs, or may scan the search field more carefully, producing much longer RTs. A change in stopping policy, notably, will produce large changes in TA RTs but have modest effects on TP RTs, altering the ratio of TA to TP slopes. In other words, if the RT differences are solely influenced by the stopping policy, then differences in TP trials will be small whereas RT differences in TA trials will be large. However, if differences in TP trials are large, then attributing RT differences to the stopping policy is not plausible.

There are many factors that affect visual search, including motivation (Sutcliffe, Ennis, & Hu, 2000), stress (Enoch, 1960; Liu, 2005), attentional deficits (Hoffman, Yang, Bovaird, & Embretson, 2006; Robertson, & Brooks, 2006), etc. Oftentimes, it is possible to affect visual search performance via priming participants (Kunar & Humphreys, 2006; Lamy, Carmel, Egeth, & Leber, 2006; Linnell & Humphreys, 2007). Some primes that have been used in the past include visual-relatedness (Hailston & Davis, 2006), shape-priming (Laarni & Nyman, 1997), verbal primes (Soto & Humphreys, 2007), and many others (Chiao, Heck, Makayama, & Ambady, 2006; Lavie & Fox, 2000; Soto & Humphreys, 2006). Typically, these primes involve some aspect of the visual system itself, and are directly related to the visual cognitive process such as 'imagining' what the target or prime looks like or having the description of the target or prime read out loud (Soto & Humphreys, 2007). However, the Kühnen *et al.* (2001) study demonstrated that priming the selves has the ability to alter visual perceptual processing. This suggests the possibility that priming the private and collective selves could also influence visual search.

Hypotheses

The purpose of the present experiments is to portray how self-priming affects the complicated task of visual search. In addition, our goal is to show *why* certain self-priming are more effective than others and to determine what specific visual

processes are being affected by these primes. To accomplish these aims, we employ a typical letter search task (Neisser, 1963; Treisman & Gelade, 1980) whereby participants must search through a series of distracters (Qs) to find the target (O) (see Figure 1 for an example of a TP trial).

The visual search task stimulus that is most frequently presented to participants is a grid comprised of letters, as depicted in Figure 1. Because of this arrangement, the tails of the 'Qs' form a Gestalt-like pattern that lines up the tails either vertically or horizontally, allowing for grouping of the stimuli to occur based on the principle of good continuation (Wertheimer, 1938). Thus, when the target is present, a break in the pattern (or lack of a tail in that particular row of 'Qs') occurs and when the target is absent, no break in the pattern occurs. Consequently, the most efficient way to conduct the search would be to simply look for a break in the pattern. Prior to the search task, participants are exposed to a private self-prime (P), a collective self-prime (C), or no self-prime (N). Based on the Kühnen *et al.* (2001) research, we expected participants primed with the collective self to place greater attention on the context compared to participants in the other conditions. Therefore, our hypothesis is that priming the collective self will also facilitate contextual attention, leading those participants to recognize the Gestalt-like pattern created by the tails of the 'Qs'. Because of this, collective self-primed participants should have faster RTs for TA and TP trials in comparison to those primed with the private self and those that receive no prime.

The advantage of a classic visual search task is that not only is there the possibility of detecting differences due to prime, but a classic visual search task will also permit more detailed detection of visual processing differences through manipulating set size. By manipulating set size we can also determine if a particular prime is assisting in performance due to (a) front-end perceptual processing and/or later response-related processes, then only the intercepts should reveal a difference in performance, whereas the set size slopes should remain constant; (b) the efficiency with which attention is guided to the target object, then the data should reveal differences in set size slopes; and lastly (c) a change in the stopping policy, then the data should only reveal set size slope differences in the TA data.

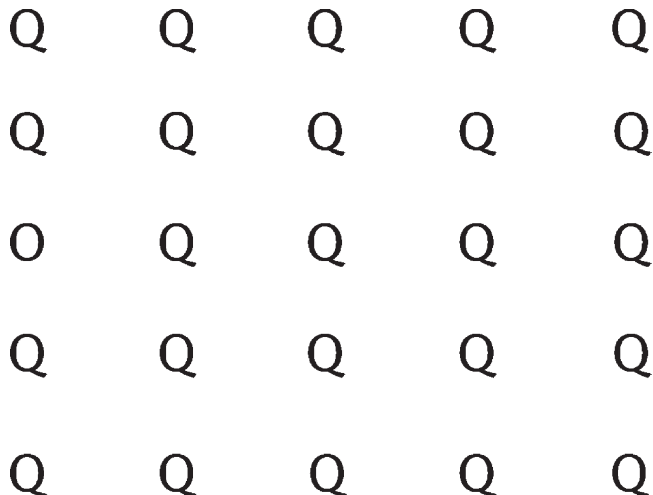


Figure 1. Sample target present display from Experiment 1.

EXPERIMENT I

Methods

Participants

Ninety adults (46 female, mean age = 19.8 years) participated for course credit. All reported normal or corrected-to-normal visual acuity. All participants were legal residents of the United States. Approximately 65% were Hispanic, 30% were Caucasian, and the remainder were Africa-American or Asian.

Apparatus and stimuli

Visual stimuli were presented on a 20" monitor resolution of $1,024 \times 768$ pixels and an 85 Hz refresh rate. Viewing distance was set at 51 cm and controlled with a chin rest. The experimental display was presented via E-prime 1.1 software.

Stimuli

Each stimulus image contained either 25 or 49 letters, arranged in either a 5×5 or 7×7 grid centred within the display. Letters were Qs and Os, $1.47^\circ \times 1.35^\circ$ degrees of visual angle in size, drawn in Lucida Sans font. Adjacent letters were separated horizontally by 5.64° and vertically by 4.18° , from centre to centre. Letters were presented in red on a black background. Figure 1 presents a sample stimulus from the set size 25 condition.

Procedure

Each participant was randomly assigned to one of three conditions: private self-priming; collective self-priming; or neutral priming. Participants began the experiment by reading a short story presented on a sheet of paper. To avoid any suspicion that the prime and visual search task was linked, participants were told that the reading task was a separate experiment on reading comprehension. Each participant saw the story in one of three versions, developed and validated in earlier research (Trafimow *et al.*, 1991), to prime the collective self, the private self, or neither. All three versions began as follows:

Sostoras, a warrior in ancient Sumer, was largely responsible for the success of Sargon I in conquering all of Mesopotamia. As a result, he was rewarded with a small kingdom of his own to rule.

About 10 years later, Sargon I was conscripting warriors for a new war. Sostoras was obligated to send a detachment of soldiers to aid Sargon I. He had to decide who to put in command of the detachment.

The story for the collective prime condition concluded:

After thinking about it for a long time, Sostoras eventually decided on Tiglath, who was a member of his family. This appointment had several advantages. Sostoras was able to show his loyalty to his family. He was also about to cement their loyalty to him. In addition, having Tiglath as the commander increases the power and prestige of the family. Finally, if Tiglath performed well, Sargon I would be indebted to the family.

The story for the private prime condition concluded:

After thinking about it for a long time, Sostoras eventually decided on Tiglath, who was a talented general. This appointment had several advantages. Sostoras was able to make an excellent

general indebted to him. This would solidify Sostoras' hold on his own dominion. In addition, the very fact of having a general such a Tiglath as his personal representative would greatly increase Sostoras' prestige. Finally, sending his best general would be likely to make Sargon I grateful. Consequently, there was the possibility of getting rewarded by Sargon I.

The story for the neutral-priming condition concluded:

After thinking about it for a long time, Sostoras eventually decided on Tiglath, who was a talented general.

After reading the story, participants in the private prime condition were asked to write down five ways in which Sostoras could help himself, participants in the collective prime condition were asked to write down five ways Sostoras could help his family, and participants in the neutral prime condition were asked to write down five routine things they accomplished during the course of a normal day.

Once the priming portion of the experiment was completed, participants were told that they were going to start a new experiment and they immediately began the visual search task. Instructions were presented in the experimental display, and questions were answered verbally by the experimenter. Participants pressed a key when they were ready to begin the experiment itself.

Each trial began with a 1,000 ms fixation cross followed immediately by the imperative display. On TA trials, the imperative display contained all Qs. On TP trials, one randomly selected Q was replaced with an O. The participants' task was to search for a target letter O, and to press the J key on the experimental computer's keyboard if a target was present and the F key otherwise. The imperative display remained visible until a response was made or 10 seconds had passed. If a response was made in the allotted time, a subsequent feedback display appeared with the message 'Correct!' or 'Incorrect!' If no response was made, the trial was scored as an error and a feedback message reading 'no response detected' appeared. Feedback remained visible for 1,000 ms, followed immediately by the next trial. Participants were instructed to make responses quickly while maintaining high accuracy.

Design

Participants were randomly assigned in equal numbers to the three priming conditions. Because pilot data suggested a sharp decrease in the strength of priming after approximately 45–50 trials, each participant was asked to perform 50 (25 TP and 25 TA) trials of the visual search task. Given the small number of trials per participant, set size was manipulated as a between-subjects variable, rather than as a within-subjects variable, which is often more typical in visual search studies. Target presence was determined randomly each trial, with a target equally likely to be present or absent.

Results

Data from one participant were lost due to a corrupted data file. Data for RT and accuracy are reported in Table 1.

RTs

RTs shorter than 300 ms or more than three standard deviations above the mean RT for a given condition for each participant were excluded from analysis. Since the data were

Table 1. Means and standard deviations from Experiment 1

Type of prime	Reaction time		Accuracy	
	Set size		25	49
	25	49		
No self-priming				
TA	4,420 (1,124)	7,982 (2,218)	95 (6.2)	97 (2.1)
TP	2,581 (598)	4,586 (971)	84 (7.9)	78 (13.3)
Private self-priming				
TA	4,326 (1,168)	8,845 (2,877)	94 (7.2)	94 (7.6)
TP	2,558 (655)	5,097 (2,333)	81 (10.8)	79 (9.8)
Collective self-priming				
TA	3,338 (1,361)	5,130 (2,037)	95 (7.5)	92 (8.8)
TP	1,916 (564)	3,192 (1,333)	79 (13.0)	75 (14.6)

Note. Standard deviations are provided in parentheses. TA, target absent; TP, target present.

not significantly skewed (for both correct and incorrect trials), the data were not transformed. As is customary for visual search data, only RTs during correct trials (approximately 87% of the total data) were included in the following analyses. These data are reported in Figure 2.

For analysis, data were submitted to a three-way mixed ANOVA with prime (private self prime, collective self prime, and neutral prime) and set size (25 vs. 49) as between-subjects factors and target presence (present vs. absent) as a within-subjects factor. As expected, RTs increased with set size, $F(1, 83) = 68.05, p < .01, f = .90$ and were faster for TP than for TA responses, $F(1, 83) = 404.15, p < .001, f = 2.2$. More importantly, this analysis also produced a main effect of prime, $F(2, 83) = 12.47, p < .001, f = .55$. Tukey's *post hoc* tests revealed that responses in the collective prime condition were faster than in either of the other prime conditions ($p < .01$ for both tests).

The main effects were qualified by significant interactions. A target presence by set size interaction, $F(1, 83) = 33.35, p < .01, f = .63$, revealed that increased set size produced longer RTs in TA trials compared to TP trials. A significant two-way interaction of prime by target presence, $F(2, 83) = 8.41, p < .01, f = .45$, indicated that the effects prime had on mean RTs was larger for TA than for TP conditions. A two-way interaction of prime by set size, $F(2, 83) = 3.36, p < .05, f = .28$, and a significant three-way interaction, $F(2, 83) = 3.45, p < .05, f = .29$, provided evidence that prime modulated RT slopes for visual search; that is, the slopes for the collective prime condition were more shallow than those of the neutral or private prime condition. These interactions are as expected within a serial self-terminating search, since, as noted in the Introduction, any manipulation that affects RT slopes will have a larger effect on TA than on TP conditions.

To explore these interactions further, planned contrasts were performed on TA and TP trials within set size to determine whether reaction times were faster in the collective versus neutral and private prime conditions. For TP trials the analyses indicated that RTs were faster in the collective prime condition compared to the neutral and private conditions when the set size was 49, $F(1, 83) = 17.95, p < .01, f = .46$. However, RTs for TP trials did not differ significantly by prime within the 25 set size condition, $F(1, 83) = 2.85, p > .05$. Analysis of TA trials revealed a similar trend; response times did not differ by prime within the 25 set size condition,

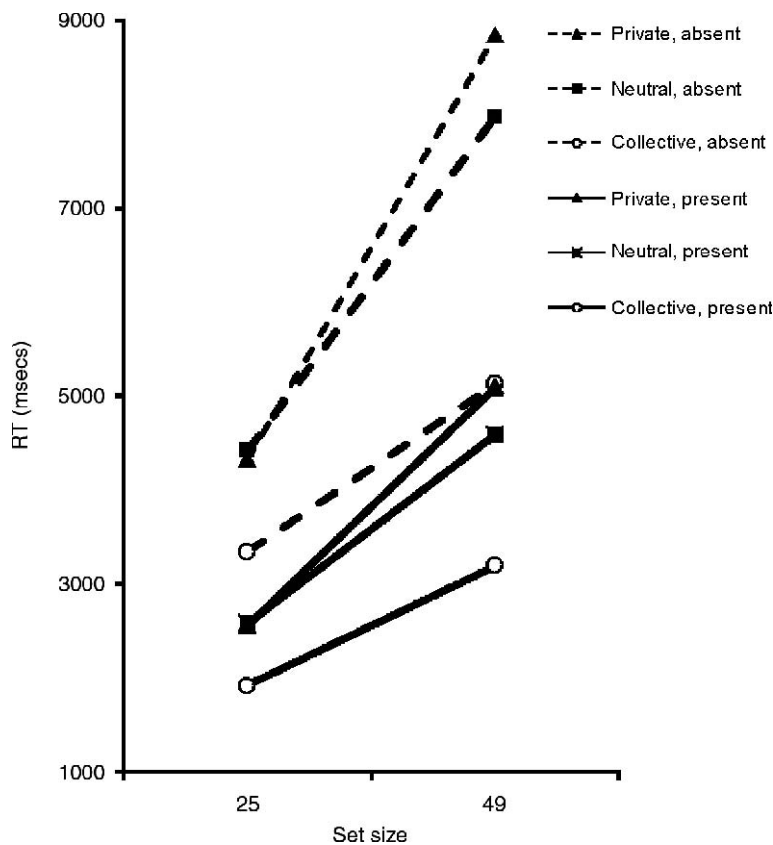


Figure 2. Response times for Experiment I as a function of condition, set size, and the presence or absence of targets.

$F(1, 83) = 2.99, p > .05$. Within the 49 set size condition, however, collectively primed participants responded faster than those in the neutral and private prime conditions, $F(1, 83) = 29.76, p < .01, f = .59$.

To confirm that RT benefits produced by collective-self priming conditions were due to the effects of the prime on search efficiency, and not due to changes in the speed of response execution or other processes, linear RT by set size functions were calculated based on the data. If there were only differences in intercepts as a function of the prime, then one could argue that the collective self-prime did not change the visual search strategy, but instead had its effect on pre-attentive processing, response selection, or response execution (Wolfe, 2002). In order to rule out these other interpretations, the intercepts and slopes were calculated for each priming group. Values are presented in Table 2. RT slopes for the collective self-priming condition were clearly shallower than those for either the neutral prime or the private self-priming condition. The prime \times set size interaction confirms this effect.

In contrast, the self-priming manipulation had no discernible effect on the RT intercepts. These results confirm that RT benefits produced by collective-self priming conditions were due to the effects of the prime on search efficiency, as reflected in RT slopes, and not due to differences in pre-attentive processing or response selection and execution.

Table 2. Mean search intercepts (ms) and slopes (ms/item) for Experiment 1

Prime	Intercept		Slope	
	TP	TA	TP	TA
No self-prime	492	710	84	148
Private self-prime	-87	-381	106	188
Collective self-prime	587	1,471	53	75

Note. TA, target absent; TP, target present.

Non-parametric analyses

In order to address the possibility that a few extreme scores skewed the group means and produced potential Type 1 errors, the following binomial comparisons were conducted: (a) neutral vs. private; (b) neutral vs. collective; and (c) private vs. collective. These were done by calculating the mean RT for each trial and then showing that the mean RT for one condition was faster than the mean RT for another condition on X number of trials. Two-tailed tests were used for all analyses.

In the TP 25 set size data, the private self-priming condition resulted in quicker RTs relative to the neutral self-priming condition only 46% of the time, $p > .10$; however, the collective self-priming condition resulted in quicker RTs relative to the neutral self-priming condition 78% of the time, $p < .0001$. The collective self-priming condition resulted in quicker RTs relative to the private self-priming condition 82% of the time, $p < .0001$. In the TP 49 set size data, the private self-priming condition resulted in quicker RTs relative to the neutral self-priming condition only 38% of the time, $p > .10$; however, the collective self-priming condition resulted in quicker RTs relative to the neutral self-priming condition 82% of the time, $p < .0001$. The collective self-priming condition resulted in quicker RTs relative to the private self-priming condition 88% of the time, $p < .0001$.

In the TA 25 set size data, the private self-priming condition resulted in quicker RTs relative to the neutral self-priming condition only 60% of the time, $p > .10$; however, the collective self-priming condition resulted in quicker RTs relative to the neutral self-priming condition 96% of the time, $p < .0001$. The collective self-priming condition resulted in quicker RTs relative to the private self-priming condition 90% of the time, $p < .0001$. In the TA 49 set size data, the private self-priming condition resulted in quicker RTs relative to the neutral self-priming condition only 36% of the time, $p > .05$; however, the collective self-priming condition resulted in quicker RTs relative to the neutral self-priming condition 98% of the time, $p < .0001$. The collective self-priming condition resulted in quicker RTs relative to the private self-priming condition 100% of the time, $p < .0001$.

These data clearly indicate that the parametric analyses were not skewed by unusual scores within particular trials, but that the pattern of superior performance in the collective self-priming condition was consistent.

Error rates

An ANOVA identical to that used for analysis of RTs revealed a significant main effect of target presence ($M = 20.7\%$ for TP trials, $M = 5.5\%$ for TA trials), $F(1, 83) = 147.47$, $p < .01$, $f = 1.39$, but no further significant effects (all $ps > .10$). These data argue against the possibility of a speed-accuracy trade-off; that is, the advantages in RTs seen for the collective priming condition did not come at the expense of decreased accuracy in that condition.

Discussion

Since the collective self-prime produced large changes in TA RTs and large changes in TP RTs within the 49 set size trials, a difference in stopping policy for collective self-primed participants, private self-primed participants, and neutral participants is not plausible. In order to attribute RT differences to the stopping policy, large differences in TA trials in comparison to small differences in TP trials would have to be demonstrated. Therefore, the data from Experiment 1 demonstrate that collective self-priming does indeed improve the efficiency of visual search in both TA and TP trials. There are at least two ways to account for this effect. The first explanation as to why our hypothesis was supported is that priming the collective self actually did facilitate contextual attention, leading those participants to recognize the Gestalt-like pattern created by the tails of the 'Qs'. One experiment that demonstrates Gestalt-like pattern perception being facilitated with the use of a collective prime is by Kühnen and Oyserman (2002). They presented participants with a large letter 'H' constructed of small letter 'Fs' and asked participants to detect either the letter 'F' or the letter 'H' after being primed with the collective or private self. As expected, collective self-primed participants detected the large letter 'H' faster than private self-primed participants and private self-primed participants detected the letter 'F' faster than participants primed with the collective self. This finding suggests that the context dependency initiated by a collective self-prime is instrumental in pattern detection which in turn, increases the speed that collectively self-primed participants can locate a stimulus.

However, a second reason could be that collective self-priming might influence motivation or effort, possibly by activating the concept of social responsibility that is connected to one's membership in groups. If the efficiency of search was determined in part by the collectively primed participants' tendency to perceive the Gestalt-like pattern, then removing the pattern should, in turn, remove this ability and prevent the collectively primed participants from outperforming the privately primed and neutral participants. However, if the performance effects of collectively primed participants were due to increased motivation because of group responsibility, then removing the pattern should not lead to decreased performance.

To test the perceptual grouping hypothesis, Experiment 2 repeated the procedure of the first experiment, but altered the search stimuli to discourage distractor grouping. In Experiment 1, distracters were identical Qs arranged to form a regular grid. Thus as previously mentioned, in addition to similarity of shape and colour, stimuli could also be grouped on the basis of good continuation (Wertheimer, 1938), vertically and horizontally between full distracter shapes, and diagonally between tails of the distracters. To reduce the strength of distracter grouping, the positions of the target and distractor items were jittered so as to prevent the grouping of the distracters.

EXPERIMENT 2

Methods

Participants

Ninety adults (59 female, mean age = 19.9 years) participated for course credit. All reported normal or corrected to normal visual acuity. The demographics were similar to Experiment 1.

Stimuli and procedure

Stimuli and procedure were identical to those of Experiment 1 except that individual stimulus letters within each display were randomly jittered by up to $\pm 2.82^\circ$ horizontally and $\pm 2.09^\circ$ vertically. The randomly jittered placement of each distracter remained constant throughout each trial; only the placement of the target letter changed positions on each trial. Figure 3 presents a sample stimulus from the set size 25 condition.

Results and discussion

Data from one participant were dropped because the participant quit before the experiment had ended.

RT

RT data were analysed as in Experiment 1. These data are reported in Figure 4. Analysis produced significant main effects of set size, $F(1, 83) = 42.92$, $p < .01$, $f = .72$, and target presence, $F(1, 83) = 467.49$, $p < .01$, $f = 2.29$, along with a significant interaction of set size and target presence, $F(1, 83) = 28.32$, $p < .01$, $f = .58$. In contrast to the results of Experiment 1, however, there was no significant main effect of prime, $F(2, 83) < 1.0$, and no significant interactions involving prime (all $ps > .10$). Thus, a disruption of perceptual grouping, caused by jittering the stimulus items, eliminated the effect of priming on visual search speed.

Error rates

Error rates showed significant main effects of set size, $F(1, 83) = 20.33$, $p < .01$, $f = .50$, and target presence, $F(1, 83) = 286.88$, $p < .01$, $f = .50$, as well as a significant interaction of the two, $F(1, 83) = 36.24$, $p < .01$, $f = .65$. Neither the main effect or prime, $F(2, 83) < 1.0$, nor any additional interactions (all $ps > .10$) were significant, however. As with the RT data, accuracy data thus revealed no advantage for the collective self-priming participants relative to other participants.

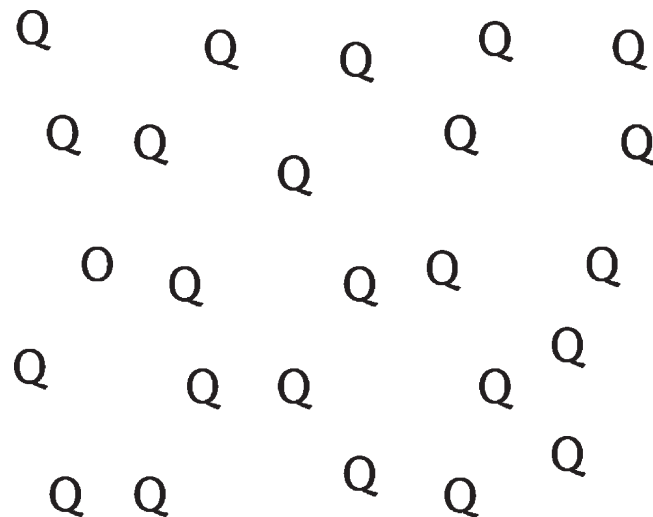


Figure 3. Sample target present display from Experiment 2.

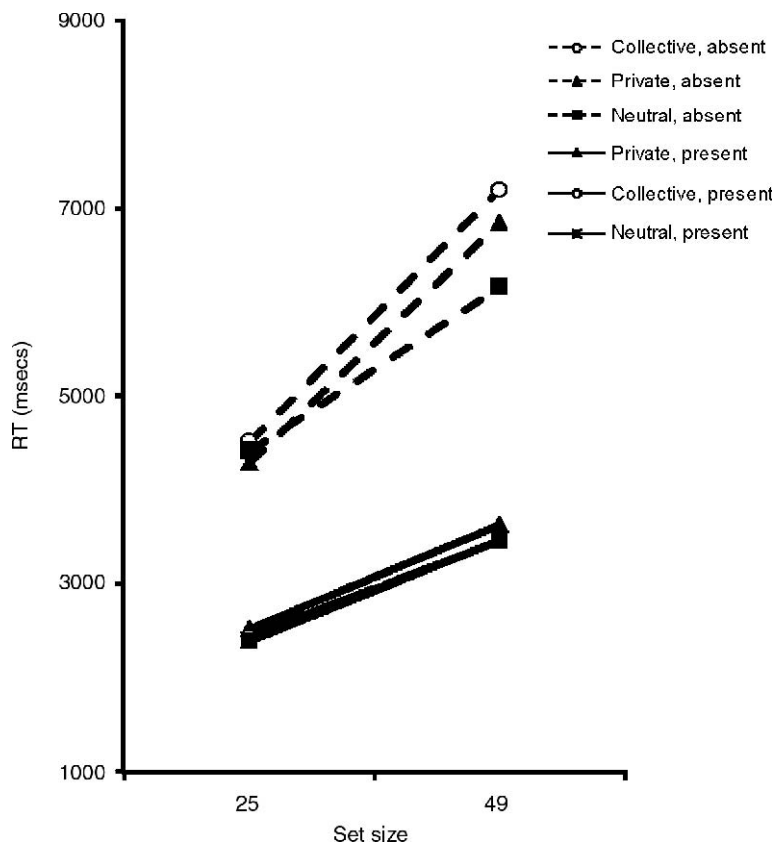


Figure 4. Response times for Experiment 2 as a function of condition, set size, and the presence or absence of targets.

Power analysis

To ensure that the results of Experiment 2 were not the result of a type 2 error we used the GPOWER programme (Faul, Erdfelder, Lang, & Buchner, 2007) to conduct a *post hoc* power analysis based on the design of Experiment 1 and 2 [2 (set size) × 3 (prime) × 2 (target presence) mixed design], with a sample size of $N = 89$, a high correlation between our repeated measures ($r = .80$), and an alpha criterion of .05. We computed the power to detect a true effect based on both a small ($f = .10$) and medium ($f = .25$) effect size (Cohen, 1988). For small effect sizes we found that the non-centrality parameter value was equal to $\lambda = 8.9$, and power equalled $(1 - \beta) = 0.63$. For medium effect sizes, the non-centrality parameter and power increased greatly, $\lambda = 55.63$, $(1 - \beta) = 0.99$. If these values are compared to the actual effect sizes and correlations between repeated measures found in Experiment 1 and Experiment 2, we may safely conclude that both studies had sufficient power to detect effects. In Experiment 1, a medium effect size ($f = .29$) was found for the three-way interaction between size, target, and prime, and the correlation between target absence and target presence was high ($r = .92, p < .01$). In Experiment 2, although the three-way interaction was non-significant, it yielded a small to medium effect size ($f = .19$) and the correlation between repeated measures was high ($r = .87, p < .01$).

Finally, we conducted a sensitivity power analysis to determine the effect size Experiment 2 was able to detect using an underestimate of power ($1 - \beta$) = 0.63, the sample size ($N = 89$), alpha, and the actual correlation between repeated measures ($r = .87$). This analysis indicated that Experiment 2 was sufficiently sensitive to detect effect sizes of $f = .08$ or larger. Thus, the lack of significant results in Experiment 2 can safely be attributed to the experimental manipulation of the scattered visual pattern, rather than to a lack of power or sensitivity.

GENERAL DISCUSSION

The present results suggest that collective self-priming makes people more likely to utilize a pattern to facilitate visual search when there is a pattern present to be perceived. In Experiment 1, participants in the collective self-prime condition showed more efficient visual search than participants in the private self-prime or neutral-prime conditions. In Experiment 2, where stimuli were manipulated to discourage perceptual grouping, self-priming had no effect on search rate.

Social psychology implications

Possibly the most obvious implication is for research in the self-priming area. Trafimow *et al.* (1991) demonstrated that priming different self-concepts could affect the accessibility of various kinds of self-cognitions and many researchers have helped to flesh out their thinking by obtaining similar effects using a variety of different priming techniques and dependent variables (Gardner *et al.*, 1999; Kimmelmeir & Cheng, 2004; Kühnen & Haberstroh, 2005; Kühnen *et al.*, 2001; Madson & Trafimow, 2001; Trafimow *et al.*, 1997; Ybarra & Trafimow, 1998). Kühnen and his colleagues; provided another important extension by demonstrating that self-priming could influence the accessibility of cognitive processes as well as cognitive content with the use of the EFT, HAWIE-R (Kühnen *et al.*, 2001), and a Gestalt-pattern letter stimulus (Kühnen & Oyserman, 2002). The present research, in turn, goes even further by explicating, much more precisely than has been done thus far, what one of these processes is. That is, we now know that collective self-priming causes people to more quickly perceive patterns and to discover visual search strategies that make use of those patterns. The next step might be to investigate precisely what it is about priming the collective self that causes an increase in pattern perception. One of the concepts that the collective self comprises is that of groups, which might be the crucial element for explaining the present data. It would be interesting to attempt to decompose the collective self into more molecular concepts that could be primed somewhat independently of each other to determine which aspects of the collective self are most connected with particular processes or contents.

The data also have implications for cultural differences in perception. There is evidence that collectivists (particularly East Asians) are better than individualists at solving tasks where contextual processing is an important component (see Nisbett, 2003/2004 for a review). The most obvious explanation, and one which has been supported (Ji *et al.*, 2000; Masuda & Nisbett, 2001, 2006; Miyamoto *et al.*, 2006), is that collectivists tend to attend more to context than do individualists whereas individualists spend more time processing the figure than do collectivists. Although we have no quarrel with this explanation, the present data suggest an additional possibility. To start with, there is evidence that members of collectivist cultures have more accessible

collective selves than do members of individualist cultures (Cousins, 1989; Fiske *et al.*, 1998; Kitayama *et al.*, 2000; Kito & Lee, 2004; Markus & Kitayama, 1991, 1998; Singelis, 1994). In addition, the present research demonstrates that a more accessible collective self increases the efficacy of pattern perception. Combining the implications of both of these lines of research suggests that members of collectivist cultures, who have more accessible collective selves, may have superior ability at pattern perception which, in turn, increases performance of context dependent tasks. Thus, the advantage for members of collectivist cultures may not only be a matter of the amount of attention given to context but also a matter of the particular way that contextual information is processed. Obviously, it will be up to future research to test this implication.

The foregoing reasoning suggests a further implication. Suppose that individualists or collectivists are primed with the private self, the collective self, or are not primed. In addition, suppose that the participants perform a task where there is a figure and a context but where it is possible or not possible to perceive a pattern in that context that would facilitate task performance. Kühnen *et al.* (2001), Ji *et al.* (2000), Masuda and Nisbett (2001, 2006), and Miyamoto *et al.* (2006) have demonstrated that collectivists spend more time processing context than do individualists but the present research indicates that it should be possible to reverse this effect. Although collectivists should spend more time processing the context than should individualists in the condition where there is no pattern to be perceived, the reverse should be so in the condition where there is a pattern to be perceived.

The findings also suggest an interesting possibility concerning the perception of in-groups and out-groups. It is well known that the collectivists distinguish between in-groups and out-groups to a greater extent than do individualists (Gomez *et al.*, 2000; Triandis, 1995, 2001) and it has also been demonstrated that self-priming influences this process (Finlay & Trafimow, 1998). The present findings, however, suggest the possibility that there is more to this process than has hitherto been realized because the tendency of collectivists to strongly distinguish between in-group and out-group may be an outgrowth of a much more general process. Consider again that collectivists have more accessible collective selves than do individualists and that a more accessible collective self increases the ability of people to perceive patterns. In addition, suppose that the in-group versus out-group distinction is recast as a type of pattern perception rather than as an isolated effect. In that case, rather than attributing the in-group out-group distinction to motivational factors, affective factors, or others, researchers might alternatively consider the distinction to be a natural consequence of the more general tendency for collectivists, or collective self-primed individuals of any sort, to perceive patterns. Obviously, it is too early to make a definitive statement that this is so but the possibility of having a larger principle within which the in-group versus out-group literature can be placed is indeed exciting.

Visual cognition implications

Researchers in the visual search area have obtained an impressive array of findings indicating that various types of primes influence visual search speed. In general, although these methods have been demonstrated to enable people to find target stimuli among distracting stimuli in a reduced amount of time, they tend to work by increasing the accessibility of the target stimuli or by increasing effort rather than by influencing the strategies that people actually use. The present findings constitute a very important exception. Note that we have no reason to believe that the collective self-prime enabled

people to better detect the absence of a feature (i.e. the tail of a Q) and, in fact, the data from Experiment 2 provide contradictory evidence. Rather, the collective self-prime increased people's ability to note that there was a general pattern by which the search could be conducted. Thus, two steps were involved, neither of which is directly relevant to detecting the absence of the feature but the combination of which nevertheless dramatically increased visual search speed. The first step was for participants to note that the features lined up in a particular way. The second step was for them to realize that this implied a more efficacious search strategy – that of looking for breaks in a line of features rather than looking at individual letters. It was the combination of these two steps that caused the impressive increase in visual search speed. We believe that this opens the way for visual cognition researchers to include people's perceptions of patterns and the strategies that incorporate these perceptions in their theories. At the very least, such theorizing should result in additional methods for using primes to influence global search strategies rather than being restricted to using primes that are specifically related to the characteristics of the target stimuli. Our expectation, however, is that the theories themselves will become more global as visual search researchers become more cognizant of the potential power of pattern perception to influence strategies used in visual search.

Conclusion

It is probably a cliché, but nevertheless a valid one, that good things happen when researchers integrate across domains. The present research provides a case in point. Theorizing based on both the self-priming literature and the visual search literature resulted in predictions that could not have been made on the basis of either of these literatures alone. Moreover, the resulting findings inform both areas and suggest many additional theoretical implications. Whether all, or any, of these implications survive empirical testing is something about which it is difficult to know in advance. But we are confident that in either case, such empirical testing will lead to theorizing that is increasingly more precise and more applicable to diverse research areas. One potential advantage of integration, then, is that it can lead to concepts that are not limited to a specific paradigm or to a specific research domain. A second advantage is that possibilities are discovered that would otherwise have been left unrealized. Hopefully, the present research will initiate the process of bringing both of these potential advantages to fruition.

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