Masked first name priming increases effort-related cardiovascular reactivity.

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Abstract:

Recent research on motivational intensity has shown that explicit manipulations of self-focused attention (e.g., mirrors and video cameras) increase effort-related cardiovascular responses during active coping. An experiment examined whether masked first name priming, an implicit manipulation of self-focused attention, had similar effects. Participants (n = 52 young adults) performed a self-paced cognitive task, in which they were told to get as many trials correct as possible within 5 min. During the task, the participant's first name was primed for 0%, 33%, 67%, or 100% of the trials. First name priming, regardless of its frequency, significantly increased cardiovascular reactivity, particularly systolic blood pressure (SBP) reactivity. Furthermore, the priming manipulation interacted with individual differences in trait self-focus: trait self-focus predicted higher SBP reactivity in the 0% condition, but first name priming eliminated the effects of individual differences. Implications for self-awareness research and for the emerging interest in priming effects on effort are considered.

Keywords: effort | cardiovascular activity | self-focused attention | implicit priming | motivational intensity | active coping | psychology | psychophysiology

Article:

1. Introduction

When people focus attention on the self, they evaluate the self against standards, norms, and goals. Self-focus enables people to monitor their performance and to evaluate whether they have fallen short of a goal, so it is a central mechanism in self-regulation and goal striving (Carver, 2003 and Duval and Silvia, 2001). Most of the research on how self-focus affects motivational processes has measured motivation using self-reports, behavioral measures of persistence (how long people spend working on a task), or how well people perform (for reviews, see Carver and Scheier, 1998 and Silvia and Duval, 2001a).Recent work, however, has examined how self-focus affects physiological outcomes, particularly cardiovascular reactivity, during the goal striving process (Gendolla et al., 2008, Silvia and al., 2011 and Silvia et al., 2010).

Research on self-focus and effort-related cardiovascular reactivity has used Brehm's motivational intensity theory as a framework (Brehm and Self, 1989 and Brehm et al., 1983). Wright (1996) integrated this theory with Obrist's (1981) active coping approach to develop a model of the cardiovascular dynamics of effort regulation. According to motivational intensity theory, the intensity of motivation is a function of the importance of success and the difficulty of behaviors needed to achieve the goal. For fixed-difficulty tasks, cardiovascular reactivity is a function of task difficulty, provided that success is possible and the goal is worth the effort. Reactivity is low when tasks are easy, increases as tasks become more challenging, and then declines when achieving the goal is impossible or requires more effort than is justified by the goal's importance (for reviews, see Gendolla and Richter, 2010 and Wright and Kirby, 2001). For unfixed-difficulty tasks — also known as self-paced, piece-rate, and “do your best” tasks — people can work at their own pace and thus set their own level of challenge, so cardiovascular reactivity is a function of potential motivation (Wright et al., 2002).

Self-focused attention, by inducing self-evaluation, makes achieving a goal more significant and self-relevant (Gendolla and Richter, 2010). As a result, self-focus should increase potential motivation, the amount of effort that is justified. Research thus far has supported the application of motivational intensity theory to self-focused attention. For unfixed-difficulty(self-paced) tasks, self-focused people showed higher cardiovascular reactivity, particularly systolic blood pressure (SBP) reactivity (Gendolla et al., 2008). For fixed-difficulty tasks, self-focused people didn't show greater SBP reactivity for easy or for impossible tasks, for which effort wasn't required or justified, but they did show greater SBP reactivity for tasks of intermediate difficulty (Gendolla et al., 2008, Study 2; Silvia et al., 2010). Furthermore, these interactive effects of self-focus and task difficulty on SBP reactivity have been replicated in research that assessed stable individual differences in trait self-focus instead of manipulating self-focus (Silvia et al., 2011).

To date, however, studies of self-focus and cardiovascular reactivity have used only explicit manipulations of self-focus. These manipulations pose people with obvious, salient reminders of the self, and they evoke strong feelings of self-consciousness. Common explicit manipulations involve having participants sit in front of a mirror during the experiment (Phillips and Silvia, 2005), videotaping the participants and showing their image on a monitor (Duval, 1976, Silvia and Duval, 2001b and Silvia and Phillips, 2004), or making participants feel distinctive (Silvia and Eichstaedt, 2004 and Snow et al., 2004).

A smaller tradition of self-awareness research, however, has explored implicit manipulations of self-focused attention. These manipulations direct attention to self and activate self-knowledge unobtrusively. The most common implicit manipulation is masked name priming. In one study, people were presented their last names (surnames) for 30 ms, followed by a 30 ms mask (Macrae et al., 1998). Last name priming significantly affected the self-regulation of social stereotypes. In recent work, masked first name priming (presenting the name for 27 ms and a mask for 100 ms) made people more likely to behave according to salient situational standards (Silvia and Phillips, under review). Another experiment showed that priming self-relevant pronouns (presenting “I” for 17 ms, followed by a 1000 ms mask) influenced affective regulation (Koole and Coenen, 2007).

It's currently unknown how implicit manipulations of self-focus would affect cardiovascular reactivity during active coping. Given that implicit and explicit self-focus manipulations replicate each other and evoke the same self-evaluative and self-regulatory mechanisms, one would expect implicit self-focus to have the same influence on effort-related cardiovascular reactivity. Testing the effects of name priming on effort is valuable for several reasons. First, it extends the large literature on self-focused attention and motivation into new directions, given that most of that literature was developed prior to psychology's interest in implicit processes. Second, studying name priming extends an emerging interest in implicit processes in effort regulation, such as how masked primes influence the perceived difficulty of goal attainment or an orientation to act (Gendolla and Silvestrini, 2010 and Gendolla and Silvestrini, 2011).

Finally, it's unclear how manipulated self-focus and trait self-focus jointly influence effort-related cardiovascular reactivity. Past work has shown effects for state self-focus (Gendolla et al., 2008 and Silvia et al., 2010) and for trait self-focus (Silvia et al., 2011). Self-focus research, however, often finds interactions between manipulated and measured self-focus (e.g., Buss and Scheier, 1976, Carver and Scheier, 1978 and Kleinke et al., 1998). In a recent review, Fenigstein (2009) remarked that the nature of these interactions remains obscure — some studies find that state manipulations diminish the effects of individual differences (e.g., Carver and Scheier, 1978), whereas other studies find that state self-focus amplifies the effects of individual differences (e.g., Brockner, 1979) — so it is important for research to untangle how states and traits interact.

2. The present research

In the present experiment, we examined the effects of implicit self-focus, manipulated via masked first name priming, on cardiovascular reactivity during active coping. People completed a self-paced cognitive task, and we manipulated four levels of prime frequency during the task: 0% (a no-priming control condition), 33% of the trials, 67% of the trials, and 100% of the trials. We explored several levels of priming frequency because higher prime frequencies can sometimes lead to habituation to the prime (e.g., Silvestrini and Gendolla, in press). In addition, we measured individual differences in trait self-focus and examined its effects on cardiovascular reactivity, particularly if it interacted with name priming.

To assess effort, we measured reactivity (change from baseline to task) for systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR). Of these parameters, SBP reactivity is the parameter most closely linked to effort (Wright, 1996). A large literature indicates that it is a reliable and consistent indicator of effort during active coping (e.g., Bongard, 1995, Gerin et al., 1995, Light, 1981, Richter et al., 2008, Richter and Gendolla, 2009, Sherwood et al., 1990 and Smith et al., 2000). DBP reactivity often tracks SBP reactivity, and several studies of motivational intensity have found effects for DBP (e.g., Al'Absi et al., 1997, Gendolla and Richter, 2005, Silvia et al., 2010 and Silvia and al., 2011), but it is much less consistent. HR is the least consistent of the three, although some experiments have found effects for HR reactivity (e.g., Eubanks et al., 2002).

Based on past work on motivational intensity and self-focus, we predicted that masked name priming would increase cardiovascular reactivity, particularly SBP reactivity, during the self-paced cognitive task. Because self-focus makes achieving goals and standards more significant, masked name priming should increase the amount of effort people are willing to expend. Effort during self-paced tasks is a function of the goal's importance (Wright et al., 2002), so name priming should increase effort for such tasks. We expected trait self-focus to increase effort, given past work (Silvia et al., 2011), but we didn't have specific predictions concerning how trait self-focus would interact with name priming.

3. Method

3.1. Participants and design

A total of 56 people (40 women and 16 men) enrolled in General Psychology at the University of North Carolina at Greensboro participated as part of a research participation option. Four cases were excluded (three due to equipment issues, one because the participant thought she may have seen her first name), leaving a final sample of 52 people (37 women and 15 men). Based on self-reported race and ethnicity, the sample was approximately 48% European American, 31% African American, 11% Asian American, and 6% Hispanic or Latino. Age ranged from 18 to 30 (M = 18.7, SD = 1.90). The project was approved by our university's Institutional Review Board (IRB), and all participants signed an informed consent form approved by the IRB.

Name priming was manipulated with four levels — no name priming, 33% priming, 67% priming, and 100% priming — and each person was randomly assigned to one of these between-subject conditions.

3.2. Cardiovascular assessment

We measured SBP (mm Hg), DBP (mm Hg), and HR (bpm) with an automated Dinamap cardiovascular monitor (1846sx or 8100; Critikon, USA) using the oscillometric method. The experimenter placed a cuff over the brachial artery of the participant's non-dominant arm. There were four baseline assessments (one every two minutes) and five task assessments (one every minute).

3.3. Procedure

Everyone participated individually. After participants provided informed consent, the experimenter explained that the study was about how the body responded during cognitive tasks. The experiment started with a baseline period, during which participants sat quietly and completed a questionnaire. Four cardiovascular assessments were taken every two minutes during the baseline period.

3.3.1. Assessment of trait self-focus

The baseline questionnaire contained measures of individual differences in trait self-focus among many filler scales. As in our past work (Silvia et al., 2011), we used two scales: the 9-item private self-consciousness scale from the revised self-consciousness scales (Scheier and Carver, 1985) and the 12-item self-reflection scale (Grant et al., 2002). These scales assess the same construct and correlate highly (Silvia and Phillips, 2011).

3.3.2. The d2 task

The experimenter then introduced the “cognitive task,” which was a computerized version of the d2 test of attention (Brickenkamp and Zillmer, 1998). This task has been used in several recent studies of motivational intensity (Gendolla and Richter, 2005, Gendolla et al., 2008, Silvia et al., 2010 and Silvia and al., 2011). For the d2 task, a d or a p is shown on the computer screen. The d or p has up to 2 apostrophes above and below it, and people must indicate whether it is a d2 (a d with 2 apostrophes above it, 2 apostrophes below it, or with one above and one below it). Participants pressed a green button if the letter was a d with exactly 2 apostrophes and a blue button for all other items (all ps and ds with 1, 3, or 4 apostrophes). People provided responses with their dominant hand on a Cedrus RB-834 response pad (Cedrus, USA); the task was presented and controlled using SuperLab Pro 2.0.4 (Cedrus, USA).

3.3.3. Priming manipulation

Name priming was accomplished by briefly presenting the participant's first name before each trial. In the 33%, 67%, and 100% name priming conditions, the trial began with a fixation cross (250 ms) followed by the person's first name (27 ms), a random letter mask (100 ms), and the d2 item. The items remained onscreen until participants gave a response. After a 100 ms pause, the next trial began. In the name priming conditions, either one-third (33% priming), two-thirds (67% priming), or all (100% priming) of the trials presented the person's first name. Unprimed trials showed a string of random consonants for 27 ms instead of the name. In the no-priming control condition, all of the trials presented the random letter string for 27 ms. All letters were presented in 48 pt uppercase Tahoma in black against a white background. The prime and mask were explained by noting that the study was also interested in how mild distractions can influence performance.

The experimenter explained that the goal was to get as many d2 trials right during the 5 min task period. Because giving a response terminated the trial and started the next one — the task was unfixed in difficulty (Wright et al., 2002) — people could work at their own pace. To familiarize themselves with the task, people completed 22 practice trials. The practice trials were unscored, and no name priming occurred during the practice phase.

The d2 task lasted for 5 min in each condition. Cardiovascular responses were measured 5 times, once per minute, starting with the task's onset. After the task, participants were probed about the priming manipulation using the funneled approach described by Bargh and Chartrand (2000). This approach starts with global questions and impressions of the task and then shifts to questions about the priming and masking procedure, such as if people found the flashes of letters distracting. Eventually, people are asked if they think they saw anything before the random letter mask, if they thought they saw any real words, and if they thought they saw their name. Only one participant indicated that she thought she might have seen her name, and no one indicated that they thought they saw real words. The low incidence is consistent with our past work that used implicit name priming during self-paced cognitive tasks (Silvia and Phillips, under review). Afterward, participants were debriefed, thanked, and given the opportunity to ask questions about the research.

4. Results

4.1. Data reduction and analysis strategy

We averaged the final three baseline assessments to form baseline scores for SBP (α = .86), DBP (α = .90), and HR (α = .98). (The first baseline assessment was discarded because it was significantly higher than the others.) Table 1 displays the baseline values. There were no significant between-group differences in SBP, DBP, or HR for the baseline scores, according to one-way ANOVAs with S–N–K follow-up tests. The five task assessments were averaged to form overall task scores for SBP (α = .96), DBP (α = .96), and HR (α = .97). Cardiovascular reactivity was scored by computing difference (delta) scores. To test for possible carry-over or initial-value effects, we tested whether the baseline scores covaried with the difference scores. The correlation for SBP was not significant, but the correlations for DBP ($r(52) = -.33$, $p = .017$) and HR ($r(52) = -.37$, $p = .007$) were, so those analyses were conducted using difference scores that were residualized with respect to the baseline values (Llabre et al., 1991). As in our past work (Silvia et al., 2011), scores for private self-consciousness (α = .69) and self-reflection (α = .89) correlated highly ($r(52) = .73$), so the overall scale scores were standardized and averaged to form a trait self-focus composite score ($M = 0$, $SD = .93$).

Table 1. Cardiovascular baseline values.

	No priming	33% name	67% name	100% name
SBP				
M	113	115	114	113
SE	3.21	3.46	2.42	2.60
DBP				
M	67	66	64	65

	No priming	33% name	67% name	100% name
SE	2.24	2.37	1.84	2.20
HR				
M	80	88	85	79
SE	2.32	2.57	4.03	3.86

Note. SBP = systolic blood pressure; DBP = diastolic blood pressure; and HR = heart rate. SBP and DBP are in mm Hg; HR is in beats per minute. $n = 13$ per condition. Mean values are rounded to the nearest whole number.

We used regression models to estimate the effects of name priming, trait self-focus, and their interaction. Because we were not committed a priori to predictions regarding prime frequency, we estimated two models for each outcome. The first model estimated polynomial effects (linear and quadratic) of name priming, a main effect of trait self-focus, and the interactions between trait self-focus and the linear and quadratic contrasts. The second model estimated a focused comparison that contrasted the no-priming control condition (weight = − 3) with the three name priming conditions (weights = 1). This contrast compares the control condition with the average of all three name priming conditions. The second model also estimated the main effect of trait self-focus and the interaction between trait self-focus and the 3 vs. 1 contrast. The regression models were estimated in Mplus 6 using maximum likelihood with robust standard errors. All regression weights are unstandardized.

4.2. Cardiovascular reactivity

4.2.1. SBP reactivity

For SBP reactivity, the polynomial regression model found only a marginal quadratic effect of name priming ($b = -1.51$, $SE = .86$, $p = .079$), a main effect of trait self-focus ($b = 1.78$, $SE = .81$, $p = .028$), and a significant interaction between the linear contrast and trait self-focus ($b = -1.12$, $SE = .26$, $p < .001$). The lack of significant polynomial main effects for name priming is consistent with the pattern of means (see Table 2), which suggests a 3 vs. 1 pattern instead of a linear or quadratic trend.

Table 2. Cardiovascular reactivity and first name priming: descriptive statistics.

	No priming	33% name	67% name	100% name
SBP				

	No priming	33% name	67% name	100% name
M	1.26	5.27	4.09	3.69
SE	2.02	1.91	1.36	2.31
DBP				
M	−.19	− 2.11	.31	1.99
SE	1.32	1.66	1.91	1.60
HR				
M	−.12	−1.17	1.92	−.62
SE	1.33	1.12	1.63	1.14

Note. SBP = systolic blood pressure; DBP = diastolic blood pressure; and HR = heart rate. SBP and DBP are in mm Hg; HR is in beats per minute. $n = 13$ per condition. Values for DBP and HR are baseline-corrected.

The 3 vs. 1 contrast model, in fact, found a significant main effect for the 3 vs. 1 contrast ($b = 1.25$, $SE = .40$,$p = .002$), a significant main effect of trait self-focus ($b = 1.72$, $SE = .71$, $p = .016$), and a significant interaction between the contrast and trait self-focus ($b = -1.39$, $SE = .37$, $p < .001$). Fig. 1 illustrates the interaction using the predicted values from the above regression weights (intercept = 3.14). Trait self-focus was evaluated at values of − 1.5 (low) and 1.5 (high), which are approximately 1.5 standard deviations away from its mean of zero and are well within its range of observed values. In the control condition, people high in trait self-focus had significantly higher SBP reactivity than people low in trait self-focus ($r(13) = .77$,$p = .002$). This finding extends past work on trait self-focus and SBP reactivity for fixed-difficulty tasks (Silvia et al., 2011) and on state self-focus for self-paced tasks (Gendolla et al., 2008). In the name priming conditions, however, trait self-focus didn't affect SBP reactivity ($r(39) = .04$, $p = .79$). The name priming manipulation thus washed out the effects of individual differences.

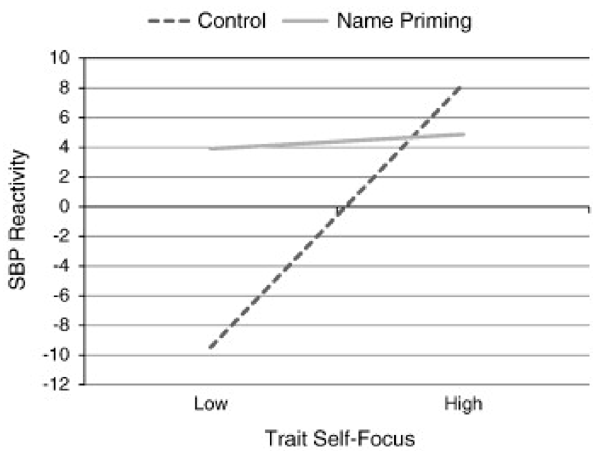

Fig. 1. Predicted values for the interaction of trait self-focus and name priming on SBP reactivity.

4.2.2. DBP reactivity

For DBP reactivity, the polynomial regression model revealed only a marginal effect of the linear trend (b = .52, SE = .31, p = .097) and a significant interaction between the linear trend and trait self-focus (b = −.46, SE = .21, p = .026). The 3 vs. 1 contrast model revealed no significant main effects, but there was a marginal interaction between the 3 vs. 1 contrast and trait self-focus (b = −.64, SE = .33, p = .054). The pattern resembled the interaction for SBP reactivity: Trait self-focus more strongly predicted DBP reactivity in the control condition ($r(13)$ = .38, p = .19) than in the name priming conditions ($r(39)$ = −.09, p = .58). Table 2 depicts DBP reactivity across the four name priming conditions.

4.2.3. HR reactivity

For HR reactivity, the polynomial regression model revealed only a marginal interaction between the linear trend and trait self-focus (b = −.46, SE = .27, p = .085). The 3 vs. 1 contrast model yielded no significant main effects or interactions. Table 2 depicts HR reactivity across the four name priming conditions.

4.3. Task performance

We explored effects on performance during the 5 min d2 task, particularly the number of errors, the number of correct trials, and average response time (RT) for the correct trials. As before, we estimated both polynomial and 3 vs. 1 regression models. Table 3 depicts the descriptive statistics. For errors, the polynomial regression model found a significant quadratic trend (b = 3.65, SE = 1.61, p = .023), reflecting more errors in the control and 100% priming conditions, and a significant interaction between trait self-focus and the quadratic trend (b = 3.30, SE = 1.57, p = .035), reflecting a weaker quadratic effect among people low in trait self-focus. No effects appeared for the 3 vs. 1 contrast model.

Table 3. Name priming effects on task performance: descriptive statistics.

	No priming	33% name	67% name	100% name
Response time	645 (24.79)	706 (25.12)	657 (34.14)	634 (15.58)
Correct trials	248 (7.15)	247 (5.60)	260 (7.09)	256 (4.84)
Errors	16.5 (4.71)	5.9 (1.26)	7.2 (2.62)	12.4 (3.73)

Note. Standard errors are in parentheses. Mean response times and correct trials are rounded to the nearest whole number. $n = 13$ per condition.

For number of correct trials, only a main effect for trait self-focus was found for both the polynomial model ($b = -6.55$, $SE = 3.26$, $p = .045$) and the 3 vs. 1 contrast model ($b = -6.01$, $SE = 3.03$, $p = .047$): People high in trait self-focus completed fewer correct trials overall. For RT, there was a marginal main effect for the quadratic trend ($b = -22.24$, $SE = 11.47$, $p = .052$), reflecting faster responses in the control and 100% priming conditions, as well as a main effect for trait self-focus ($b = 26.04$, $SE = 12.89$, $p = .043$), reflecting longer RTs as trait self-focus increased; the 3 vs. 1 regression model found only a marginal main effect of trait self-focus ($b = 23.97$, $SE = 12.72$, $p = .060$).

Finally, we examined the correlations between cardiovascular reactivity scores and the measures of performance. SBP and DBP reactivity did not correlate significantly with RT, number of correct trials, or errors. As HR reactivity increased, however, people completed more correct trials ($r(52) = .298$, $p = .032$) and had faster response times ($r(52) = -.319$, $p = .021$).

5. General discussion

The present research bridges three traditions in self-awareness research. One line of work shows that explicit manipulations of self-focus influence effort-related cardiovascular responses in the manner predicted by motivational intensity theory (Gendolla et al., 2008 and Silvia et al., 2010). A second line of work shows that implicit manipulations of self-focus influence self-regulation, albeit for measures of judgment and behavior and not for physiological outcomes (Koole and Coenen, 2007, Macrae et al., 1998 and Silvia and Phillips, under review). Finally, a third line of work shows that state and trait self-focus can interactively influence motivation and self-regulation, although the form of the interaction remains unclear (Fenigstein, 2009).

In our experiment, we found that masked first name priming influenced SBP reactivity during the self-paced task. Interestingly, the relative priming frequency (33%, 67%, or 100%) seemed unimportant; regression models found significant support for a 3 vs. 1 pattern (all priming conditions vs. the control) but not for polynomial effects of priming. Thus, this study provides the first evidence that implicit manipulations of self-focus influence SBP reactivity in the manner expected by motivational intensity theory. The similar effects across priming frequency is consistent with past work on masked name priming, which has varied frequency across studies. Some studies presented names for 100% of the trials (Silvia and Phillips, under review), but others have primed only some of the trials (e.g., 50%; Koole and Coenen, 2007;Macrae et al., 1998).

Furthermore, we found that state and trait self-focus significantly interacted. When state self-focus was low (the 0% priming condition), trait self-focus significantly predicted SBP reactivity. This effect extends recent work on trait self-focus (Silvia et al., 2011), which found that trait self-focus predicted patterns of SBP reactivity for fixed-difficulty tasks, as well as experimental studies of unfixed-difficulty tasks that manipulated self-focus (Gendolla et al., 2008). When state self-focus was high (33%, 67%, 100% name priming), however, trait self-focus was unrelated to SBP reactivity — the manipulation elevated SBP reactivity regardless of individual differences. The form of the interaction is thus similar to past work that found that state self-focus tends to attenuate rather than intensify the effects of trait self-focus (e.g., Carver and Scheier, 1978).

As expected based on past research on effort-related cardiovascular reactivity, the strongest effects appeared for SBP reactivity. DBP reactivity showed the same broad pattern, but the effects were weaker, and HR reactivity showed only one marginal effect. A large body of work has found that SBP is the most reliable marker of effort of the three (Gendolla et al., in press), but our assessment method is unable to illuminate the physiological mechanisms underneath its effects. Recent work on motivational intensity theory has applied more sophisticated techniques to understanding the role of the cardiovascular system in effort, such as parameters derived from impedance cardiography (e.g., Capa and Audiffren, 2009 and Richter and Gendolla, 2009), and these would be a fruitful direction for future research on self-focus and effort.

5.1. Effort and performance

Effort-related cardiovascular reactivity and task performance were only loosely coupled in the present data. Intuition suggests that effort should translate into performance, but the relationships between effort and task outcomes are complex (Hockey, 1997). Task performance is affected by many factors beyond effort (e.g., abilities, knowledge, and strategies relevant to a task), so research commonly finds dissociations between effort-related physiological processes and task performance (e.g., Richter and Gendolla, 2009 and Silvia et al., 2010). For the sample as a whole, HR reactivity predicted more efficient performance (faster RTs and completing more correct trials), but SBP and DBP reactivity did not.

Interestingly, people high in trait self-focus showed higher SBP reactivity but worse performance (slower RTs and fewer correct trials), which is consistent with the use of a “double-check” or “caution” strategy (Knowles and Delaney, 2005). A common error on the d2 task involves the d with one apostrophe above and one apostrophe below it. One way to try to get more items correct (the task's goal) is to avoid making mistakes, but this reduces speed and hence total trials completed. This illustrates a scenario in which greater effort is associated with less efficient performance because people adopted a less fruitful task strategy.

Future work should parametrically investigate factors that influence the coupling of effort-related physiological responses and task performance. It seems likely that tasks involving executive abilities (such as the d2 task) are less strongly affected by effort than tasks that involve simple retrieval and matching processes (e.g., Gendolla and Silvestrini, 2010). As fluid cognitive abilities (e.g., executive attention, working memory, and fluid intelligence) account for more variance in task performance, there is less variance available to be explained by effort. Moreover, in such cases, people lower in fluid cognitive abilities will find the task harder and thus may mobilize more effort (provided the goal is worthwhile and success seems feasible), an example of compensatory effort (Hockey, 1997).

5.2. Implications for priming and motivational intensity

In addition to replicating and extending recent work on self-focused attention, the present findings add to an emerging interest in how priming can influence effort-related cardiovascular responses. Traditionally, research testing motivational intensity theory has concerned conscious, explicit processes, such as appraisals of the task's difficulty and one's abilities (Kemper et al., 2008 and Wright and Dill, 1993); conscious experiences, such as fatigue and moods (Nolte et al., 2008 and Silvestrini and Gendolla, 2009); and obvious incentives, such as gaining money or avoiding aversive events (Richter and Gendolla, 2009 and Wright et al., 1992). Recent work, however, has considered how primed information presented outside of awareness can influence effort-related physiological responses. For example, Gendolla and Silvestrini (2011) found that rapid masked presentations of sad, happy, and angry faces affected cardiovascular reactivity by influencing people's appraisals of the task's difficulty. Additionally, masked action primes — words such as run, go, and fast — can directly influence cardiovascular reactivity during active coping (Gendolla and Silvestrini, 2010), and pairing a subliminally presented goal with consciously presented positive words increases several cardiovascular markers of effort (Capa et al., in press).

In the present work, we found evidence that masked priming can influence potential motivation, the importance of achieving the goal. Because effort-related reactivity in self-paced tasks is a function of goal importance (Wright et al., 2002), the fact that first name priming increased SBP reactivity for the d2 task suggests that name priming has an implicit influence on potential motivation. A goal for future research is to identify how different kinds of primes interact, such as if action primes and first name primes have interactive or independent effects, given that relatively little is known about implicit influences on effort regulation.

Future work could also expand on the inner mechanics of name priming. We have proposed that masked name priming operates much like explicit manipulations of self-focus. Like those manipulations, name priming activates self-knowledge and initiates an automatic self-evaluative process (Duval and Silvia, 2001). This claim seems reasonable given the small literature on name priming, particularly the fact that explicit manipulations (e.g., showing people their reflection in a mirror) and name priming show similar effects across and within experiments (Macrae et al., 1998 and Silvia and Phillips, under review). But there are other possibilities that ought to be evaluated in future work. For example, name priming might foster activity that is consistent with habitual goals, motives, and traits, such as achievement motivation (Capa et al., 2008) or preferences for action over inaction (Albarracín et al., 2008), both of which are probably above average in a sample of American college students. These possibilities are consistent with a self-focus interpretation — many studies show that self-focus makes people more likely to behave consistently with their attitudes, goals, standards, and dispositions (Carver and Scheier, 1998 and Silvia and Gendolla, 2001) — but future work should nevertheless examine the pathways from name priming to effort-related cardiovascular activity in more detail.

One issue raised by the present research — and by work to date on priming and effort — concerns implicit and explicit awareness of primes. Priming procedures vary considerably from study to study, including the presentation speed of the prime, the masking parameters, and the nature of non-primed trials (e.g., anagrams of prime words, random letter strings, and neutral words). Given the timing and masking parameters in the present work, the name primes probably were not subliminal in the strictest sense. Because first names are highly familiar, it's possible that people could have discriminated primed from unprimed trials at above-chance levels despite a lack of conscious visual awareness of the prime. The influence of the primes is thus implicit, but we wouldn't claim based on these methods that the processes involved in the priming-effort link operate wholly outside of awareness. An experiment that parametrically manipulated priming parameters and assessed discrimination would reveal the degree to which awareness is implicated in priming effects on effort.

6. Conclusion

The present experiment extended recent research on how self-focused attention influences the intensity of effort-related cardiovascular activity. Based on motivational intensity theory (Brehm and Self, 1989), we expected that masked first name priming would make success more important, thereby increasing the amount of effort that people would be willing to expend. Consistent with the theory, masked first name priming during a self-paced cognitive task significantly increased SBP reactivity. Prime frequency (33%, 67%, or 100% of the trials) made little difference. Furthermore, individual differences in trait self-focus interacted with the name priming manipulation. Trait self-focus predicted higher SBP reactivity in the control condition, but name priming wiped out the effects of trait self-focus. Taken together, the present findings extend work on self-focus and motivational intensity, which has used only manipulations of conscious self-focus, as well as the emerging literature on how priming affects effort-related physiology.

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