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Action Dominance: The Performance Effects of Multiple Action Demands and the Benefits of an Inaction Focus

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Abstract

Four experiments uncovered an *action dominance error* by which people's natural focus on actions hinders appropriate responses to social and nonsocial stimuli. This surprising error comprises higher rates of both omission (misses) and commission (false alarms) when, in responding to action and inaction demands, people have higher numbers of action targets. The action dominance error was verified over four experiments using an analog that required responses to words and to target individuals. Experiments 1 and 2 tested our hypotheses and distinguished the action error effect from the effects of practicing action or inaction responses. Experiment 3 linked the error to the greater cognitive load imposed by the higher proportion of action over inaction targets. Further, Experiment 4 demonstrated that (a) there is a default tendency to pay more attention to action (vs. inaction) targets and (b) that shifting focus to inaction targets reduces the action dominance error.

Keywords

action goals; inaction; focus; goals; performance; motivation

Contemporary human lives are characterized by the need to juggle multiple goals that involve both action and inaction. People pursue goals of work and study but also goals to relax and regain energy, seek goals to maintain high levels of healthy physical activity while pursuing goals to avoid unhealthy food intake, and dedicate time to interact with the people they love while reducing interactions with less close others. These examples illustrate the importance of pursuing both action and inaction goals for a functional life but open several questions about the relative effects of each type of goal. For example, how good are people at juggling action and inaction demands? Do multiple simultaneous action demands interfere more with performance than multiple simultaneous inaction demands? Do people emphasize the action demands even though performance would improve if they construed the task as demanding inactions? If so, can a shift in the natural focus on action improve performance?

Competition among Multiple Goals is Taxing

A longstanding tradition of research on motivation has explored the psychological principles of setting, prioritizing, and pursuing goals (Lewin, 1935, 1951), recognizing that multiple goal pursuit is taxing and error prone. Within a prolific line of research on multiple goal competition (Carver & Scheier, 1982; Kruglanski et al., 2012; Kuhl, 1984; Schorr, Gerjets, & Scheiter, 2003) have explained goal competition as a memory process in which two competing goals develop inhibitory connections with each other. As a result of this inhibitory connection, activating the goal to eat healthy and to indulge at the same time is often difficult. This competition can be construed as a battle for executive resources that lead one goal to win and play a dominant role. When people have a focal goal, this goal exerts a “pull” that can compromise effective regulation of alternate goals (A. Kruglanski et al., 2002). This competition is resolved through a host of strategies, either conscious or unconscious, including prioritization (e.g., Shah, 2005), goal shielding (e.g., Shah et al., 2002), satisficing (e.g., Simon, 1967), and balancing and highlighting (Fishbach, Zhang, & Koo, 2009). In goal shielding, for example, activating a focal goal leads to inhibiting other goals, which is demonstrated by increases in the accessibility of concepts associated with the focal goal and corresponding decreases in the accessibility of alternate goals (Shah et al., 2002). Whichever the resolution strategy, past research has made it clear that setting multiple goals can be cognitively taxing.

Why a Chronic Focus on Action May Lead to Actions Creating a Greater Cognitive Load than Inactions: The Action Dominance Error

Despite extensive knowledge about competition among specific action goals such as the goal to eat healthy foods and the goal to eat palatable foods, to the best of our knowledge, the effects of focusing on the action or the inaction demands of a situation are not currently understood. Action goals are guided towards a high motor or cognitive output, deliberate or not, and inaction goals are guided towards low cognitive or motor output (e.g., towards a state of rest) (Albarracín et al., 2008; Albarracín & Handley, 2011; Gendolla & Silvestrini, 2010; Hepler, Wang, & Albarracín, 2012; McCulloch, Li, Hong, & Albarracín, 2012). Both action and inaction goals imply commitment of effort toward the desired end state and should operate like other goals (cf. Wright & Brehm, 1989). By definition, the satisfaction of goals should proceed through the identification of courses of action that can satisfy the goal (Bargh, 2014; A. Kruglanski et al., 2002; Moskowitz, Li, & Kirk, 2004). People may achieve action by means of active initiation of effortful behaviors or by inertia. Likewise, people may achieve inaction by means of active inhibition or by remaining in a restful state (Albarracín, Hepler, & Tannenbaum, 2011)).¹

¹Note that action and inaction goals are distinct from several important notions in the social psychological and personality literatures (Albarracín et al., 2008). Theoretically, activating a general action goal may increase promotion and prevention strategies (Higgins, 1997). Likewise, action goals may trigger different behavioral choices for high-locomotion and high-assessment people (Kruglanski et al., 2000), such that locomotors may choose motor activities and assessors may choose cognitive activities. Similarly, chronic behavioral activation and inhibition (Carver & White, 1994) and action/state orientation (Kuhl, 1984) may determine whether effective planning or rumination prevail in response to action goals. All in all, each of these constructs is orthogonal to the notion of action and inaction goals.

A critical premise of the present research is that action demands tend to be more engaging than inaction demands. We propose that people are more likely to spontaneously form action than inaction goals and are more likely to experience difficulty in response to multiple action demands than in response to multiple inaction demands. Action goals are of course critical to advance human survival by ensuring adequate shelter and food supply. This advantage connects action goals directly with controlling and interacting effectively with the environment (see (Karsh, Eitam, Mark, & Higgins, 2016; White, 1959), and is supported by some prior findings. Compared to inactions, actions receive more attention (Kahneman & Miller, 1986)), elicit stronger emotional reactions (Landman, 1987; Zhou, Yu, & Zhou, 2010), trigger higher regret (Tversky & Kahnemann, 1982), and are often perceived as more consequential (Baron & Ritov, 2004). Furthermore, across cultures, people tend to hold more positive attitudes toward action and perceive action as more important than inaction, with some Western cultures even holding negative attitudes towards inaction (Ireland, Hepler, Li, & Albarracín, 2015; Levine & Norenzayan, 1999; Zell et al., 2012). The emphasis on action may also underlie recent findings that American college students would rather undertake extreme action, like administering electric shocks to themselves, than spend any amount of time in idle thinking (Wilson et al., 2014). The findings from these literatures converge on the idea that action is more attention-driving than inaction, leading to a greater chronic focus on actions than on inactions.

Further evidence from various research domains suggests that an action may attract more attention than its absence. In animal perception and learning, pigeons are better able to associate rewards with video images of other pigeons that are moving than with other pigeons that are standing still (Dittrich & Lea, 1993). In human self-perception, people who signal agreement by producing a response later agree with a behavior more than people who signal agreement by avoiding a response (Allison & Messick, 1988; Cioffi & Garner, 1996; Fazio, Sherman, & Herr, 1982). In general, in making decisions, the *presence* of any attribute weighs more heavily than the *absence* of an attribute (Kardes, Cronley, & Kim, 2006). Therefore, action demands may be more salient and attention-catching than inaction demands.

Our research on the role of simultaneous action and inaction demands concerns situations in which the same behavior can be executed in some contexts but not in others. In this light, a chronic action focus gives way to hypothesizing the action dominance error. A person who is asked to socialize with *Ashley* may simply focus on her and ignore the three other people in a group of four people. In this situation, keeping track of the demand to talk to Ashley should be relatively easy. However, the demand to socialize with Ashley, Emily, and Michael while interacting with a group that also includes Joshua, is more difficult. In this case, forming the inaction goal of not socializing with Joshua rather than the action goal of socializing with Ashley, Emily, and Michael is likely to make the situation easier. However, focusing on not socializing with Joshua implies a switch in attention to inaction that may be difficult if people indeed have a dominant focus on action.

Despite our expectation of a dominant action focus, inaction goals have at least three possible adaptive advantages. First, desiring to not engage in a negative behavior is an essential aspect of inhibitory control of socially undesirable behaviors like aggression (for

the positive outcomes of inhibitory control, see (Eisenberg et al., 2001; Lengua, 2002; Mischel & Ayduk, 2011; Mitchell & Hall, 2014; Raver, Blackburn, Bancroft, & Torp, 1999; Rhodes, Singer, Bourgois, Friedman, & Strathdee, 2005; Shoda, Mischel, & Peake, 1990). Second, inaction is critical to conserve energy for survival and health (Albarracín et al., 2011). Specifically, successful adaptation to the environment requires a mechanism to conserve energy and should make people sensitive to demands for inaction and able to set inaction as a desirable endstate or goal in some situations. Third, inaction may exert positive influences on problem solving. For example, when all courses of action fail, awaiting environmental input may be the best solution (Albarracín et al., 2008). Therefore, it should be possible to induce an *inaction focus* (a strategy to focus on the inaction-associated stimuli to guide performance), which, in turn, reduces the action error. In a situation with a high proportion of action targets (e.g., having to wave to 3 people) and a correspondingly low proportion of inaction targets (e.g., not waving to 1 person), the best strategy of focusing on inaction may be induced to override the focus on action.

The Present Research

In the experiments participants were presented with verbal and social stimuli that required a response (action) or that required no response (inaction). The experiments manipulated the proportion of target stimuli associated with action and with inaction requests within the stimulus set (action-target proportion). If action targets produce greater cognitive load than inaction targets, then performance should be poorer with a higher proportion of action targets. That is, a higher action-target proportion should trigger more omission errors or misses in response to required action responses as well as more commission errors in response to required inaction responses.

In addition to the effects of the task targets when people learn the structure of the task (see e.g. Pashler, 1994; Ruthruff & B., 2007), the proportions of actual actions in a task should also affect the motor preparation that occurs when the behaviors are being executed. Event-related brain potentials have revealed that preparation to respond (e.g., press either *K* or *L* in response to a tone) increases the contingent negative variation, which signals intentional motor readiness and predicts faster responses and greater difficulty withholding incorrect actions (Los & Heslenfeld, 2005); (Nieuwenhuis, Yeung, van den Wildenberg, & Ridderinkhof, 2003). Furthermore, people who are routinely required to execute actions become more prepared and are faster to execute an action than those without such a requirement (Van der Molen, Boomsma, Jennings, & Nieuwboer, 1989).

To examine our hypotheses, we modified the classic Go/No-Go (GNG) task because it allowed for the simplest contrast between action and inaction demands in a cognitive performance context (for a review of GNG tasks, see (Simmonds, Pekar, & Mostofsky, 2008) and has previously been used to contrast action and inaction goals (e.g., (Hepler, Albarracín, McCulloch, & Noguchi, 2012). In our ad-hoc multiple-target Go/No-Go, participants are presented with a series of stimuli and are instructed to act by responding to a certain stimulus (action, or *go*) and to not act in response to another stimulus (inaction, or *no-go*). Performance is measured using three indices: the reaction time to the stimulus and two accuracy measures, false alarms or commission errors – indicating a response when no

response was expected, and misses or omission errors – indicating no response within the given response time when a response was expected. Based on our predictions, Experiments 1 and 2 tested the hypothesis that a higher action-target proportion in our GNG task would yield worse performance over trials that require the same number of Go and No Go responses (no prepotency). Experiment 1 also manipulated response prepotency, that is the proportion of Go and No Go responses required over trials, which is common in GNG experiments. Experiment 3 manipulated cognitive load using stimuli set size. We predicted an interaction showing that under low load, a high action-target versus a low action-target proportion should lead to more performance errors, a difference that should decrease under high load. Finally, in Experiment 4, we manipulated action-inaction focus, expecting an inaction focus to mitigate the action-dominance error by increasing attention to the inaction targets. All data are publicly available at <https://osf.io/82e4n/files/>.

Experiment 1: Action Dominance Error and Differences from Practice

Effects

In Experiment 1, the manipulation of action-target proportion (high: 75% vs. low: 25%) varied whether the initial directive to a particular target called for an action response or an inaction response, whereas the manipulation of action frequency (high: 75% vs. low: 25%) varied how often a particular target occurred during the trials. We predicted more misses and more false alarms in response to the high-action target proportion. In addition, we sought to distinguish this pattern from the effect of action *frequency* in a given condition (Van der Molen et al., 1989). The effect of frequency should simply consist of more consistent errors of more false alarms for the high-action frequency condition and correspondingly more misses for the low-action frequency condition.

Method

Participants and Design

Seventy-five undergraduates participated in the study in exchange for course credit. We calculated an N of 66 to detect a within-subjects $d = 0.5$ with an alpha of .01 and 95% power. Based on typical attendance we scheduled a larger sample of 80, and obtained 78 during the time period of the experiment. The design was a 2 within-subjects action-target proportion (high: 75% vs. low: 25%) x 2 within-subjects action frequency (high: 75% vs. low: 25%) design. Of the 75 valid participants, 50 (i.e., 66.7%) were female students, and the average age was 18.95 ($SD = 1.19$).

Procedure

Participants were told that they would be taking a visual-behavioral test requiring them to press a key in response to some words and withhold their response to some others. Four words (*YOUTH*, *DRINK*, *LIVES* and *FRESH*) were presented one at a time as target stimuli. Each word appeared for 400 milliseconds, during which participants could respond (for details, see Online Materials). Participants were instructed to press the spacebar as fast and accurately as possible in response to either three or one of these words (high: 75% vs. low: 25% action-target-proportion conditions) and to withhold their response by not pressing

any keys in response to either one or three words. Although participants were not given explicit information about the frequency of actions and inactions in the upcoming task, the task entailed words cueing action in 75% of the trials for half of the participants but 25% of the trials for the other half of the participants (high: 75% vs. low: 25% action-frequency-proportion condition). For further details, see Supplementary Materials.

Performance errors—The proportions of misses (failures to act) and false alarms (inaccurate action) in each block were square-root transformed and served as error measures. Here the proportion was defined and computed the number of misses (or false alarms) divided by the total number of trials (i.e., 72) in each block (see Supplementary Materials for details). We present back-transformed mean proportions and *SD* for each type of error in each condition.

Results and Discussion

Rates of misses and false alarms were submitted to repeated measures analyses of variance with proportion of action frequency (high: 75 % vs. low: 25%) and proportion of action targets (high: 75% vs. low: 25%) as the two within-subjects factors. Replicating past findings (Van der Molen et al., 1989), the effects of the action frequency proportion followed our prediction of errors in the direction of frequently practiced responses. That is, holding the action target-proportion constant, the 75% action-frequency-proportion condition produced more misses and fewer false alarms than the 25% action-frequency-proportion condition (for false alarms: $M_{p(FA)_HighFrequency} = .290$, $SD_{p(FA)_HighFrequency} = .000$ vs. $M_{p(FA)_LowFrequency} = .030$, $SD_{p(FA)_LowFrequency} = .000$; $F[1, 74] = 549.83$, $\eta^2 = .88$, $p < .001$; for misses: $M_{p(miss)_HighFrequency} = .233$, $SD_{p(miss)_HighFrequency} = .000$ vs. $M_{p(miss)_LowFrequency} = .531$, $SD_{p(miss)_LowFrequency} = .000$; $F[1, 74] = 318.53$, $\eta^2 = .81$, $p < .001$).

Similarly, the effects of action-target proportion revealed the expected action dominance error. When holding the action frequency constant, as the proportion of action targets increased from 25% to 75%, false alarms increased from $M_{p(FA)_25\%TargetProportion} = .071$ ($SD_{p(FA)_25\%TargetProportion} = .000$) to $M_{p(FA)_75\%TargetProportion} = .197$ ($SD_{p(FA)_75\%TargetProportion} = .000$), $F[1, 74] = 106.41$, $\eta^2 = .59$, $p < .001$; and the proportions of misses increased from $M_{p(miss)_25\%TargetProportion} = .289$, $SD_{p(miss)_25\%TargetProportion} = .000$; $M_{p(miss)_75\%TargetProportion} = .454$, $SD_{p(miss)_75\%TargetProportion} = .000$ vs. $F[1, 74] = 115.13$, $\eta^2 = .61$, $p < .001$, respectively.

We also included interaction terms between the two within-subjects factors, yet it was not significant in either models: it was $F(1, 74) = 3.92$, *n.s.*, $\eta^2 = .05$ for the proportion of false alarms; and $F(1, 74) = 0.10$, *n.s.*, $\eta^2 = .001$ for the proportion of misses, respectively.²

²We also analyzed response times in millisecond of the false alarm and hit trials for the effect of the action frequency factor. The effect of the action frequency in response time was significant for both the false alarm trials ($MRT(FA)_HighFrequency = 280.11$, $SDRT(FA)_HighFrequency = 6.25$ vs. $MRT(FA)_LowFrequency = 314.88$, $SDRT(FA)_LowFrequency = 7.29$; $F[1, 27] = 15.99$, $\eta^2 = .372$, $p < .001$), and hit trials ($MRT(HIT)_HighFrequency = 324.49$, $SDRT(HIT)_HighFrequency = 2.87$ vs. $MRT(HIT)_LowFrequency = 353.29$, $SDRT(HIT)_LowFrequency = 2.59$; $F[1, 72] = 83.43$, $\eta^2 = .54$, $p < .001$). Response times were actually not affected by the action-target-proportion manipulation in any of our experiments, and thus are not discussed further.

Experiment 2: Action Dominance Error in Response to Social Targets

Methods

Participants and Design—Sixty-five undergraduates participated in exchange for course credit ($M_{\text{age}} = 18.8$, $SD_{\text{age}} = 0.9$; 56% female). We calculated an N of 66 to detect a within-subjects $d = .5$ with an alpha of .01 and 95% power. Based on typical attendance we scheduled a larger sample of 80, and obtained 65 during the time period of the experiment. The design had 2 within-subjects action-target proportion cells (high: 75% vs. low: 25%).

Procedure—Participants were told that they would be taking a visual-behavioral test requiring them to act by pressing a key in response to some images and to not act in response to some others. Four pictures of real human faces, along with four names, were presented one at a time as target stimuli. Pictures were 8.89" x 6.67" in size and were of real people's faces taken by a digital camera. Two of the faces were female and two were male. Participants were told that the names of the people in the pictures were *Ashley*, *Emily*, *Michael*, and *Joshua*, and that the task was to wave to some of those people by pressing the spacebar and not to wave to some others by not pressing any keys. Each target picture was presented for 400ms and was preceded by an array of *Xs* as an attentional fixation point onscreen for 300ms. The black background was on for 400ms before and 100ms after the array of *Xs* (SOA: 1200ms). Please see supplementary material for full procedures, instructions, and stimuli.

Action-proportion manipulation—In a within-subject design, each participant first completed 48 trials in the high action-proportion condition with the instructions to wave at three of the four faces (75%). Then, another set of 48 trials was presented in the low action-proportion condition in which participants had to wave at only one out of the four faces (25%). The order of trials was the same for all participants, and the frequency of presented stimuli eliciting action and inaction was set at 50%–50% and the display order of stimuli within each trial was randomized.

Results and Discussion

Misses and false alarms appear in Table 1 and were submitted to two separate paired t -tests. As in Experiment 1, error was higher in the high action-proportion condition compared to the low action-proportion condition for both misses and false alarms. In other words, as predicted, Experiment 2 demonstrated that a larger action-proportion in a fixed set of action and inaction targets leads to higher rates of misses and false alarms.

Experiment 3: Action Dominance Error and Cognitive Load

To examine cognitive load as the mechanism for error, Experiment 3 manipulated the cognitive load of the task by including either eight or four target words in the GNG task. If cognitive load is indeed the cause for the greater error in higher action-proportion conditions, then the impact of the action-proportion manipulation should be smaller in high (vs. low) cognitive load conditions.

Methods

Participants and design—Sixty-five undergraduates participated in the experiment in exchange for course credit ($M_{\text{age}} = 19.3$, $SD_{\text{age}} = 1.11$; 60% female). We calculated an N of 54 to detect a within-subjects $d = .25$ with an alpha of .05 and 95% power. Based on typical attendance we scheduled a larger sample of 80, and obtained 65 during the time period of the experiment. The design was a within-subjects 2 action target proportion (high: 75% vs. low: 25%) x 2 load (high: 8 targets vs. low: 4 targets).

Procedure—Participants completed a GNG task with sets of either eight or four word targets (high versus low cognitive load conditions, respectively). The eight words in the high cognitive load condition were *youth*, *drink*, *lives*, *fresh*, *doctor*, *green*, *health*, and *energy*. The high versus low action-proportion conditions required an action response to six (75%) versus two (25%) of these eight words, respectively. These words had comparable frequency of use and number of letters. In the low-cognitive-load condition, participants responded to four words from two sets. For half of the trials, participants were instructed to respond to *youth*, *drink*, *lives*, and *fresh* and for the other half to *doctor*, *green*, *health*, and *energy*. The order of the different sets of words and the four cells of the design were randomized across participants, and order had no effect on the findings. We used the same error measures as in Experiment 1 and also measured reaction time to verify cognitive load. Please see supplementary material for a full description of the procedures, instructions, and stimuli.

Results and Discussion

The rates of misses and false alarms were separately submitted to two separate ANOVAs with proportion of action targets (high versus low) and cognitive load (high versus low) as two within-subject factors. The results are summarized in Table 2.

Cognitive load manipulation verification—As predicted, the high cognitive load condition produced a higher number of errors than the low cognitive load condition, which was apparent for both misses and false alarms. Also, the high-load condition produced relatively longer reaction times both for correct action responses (high-load: $M = 351\text{ms}$, $SD = 21$; low-load: $M = 344\text{ms}$, $SD = 20$; $F(1, 61) = 13.79$, $p < .001$) and more misses and false alarms (see Table 2). As expected then, based on the errors and the delay in all responses, the variation in the number of overall targets appeared to be a successful manipulation of cognitive load.

Action-proportion—As in Experiments 1 and 2, compared to the low action-proportion condition, participants in the high action-proportion made more errors – both more misses and more false alarms.

Reduction of the effect of action-target proportion in high cognitive load conditions—More importantly and as predicted, there was a significant interaction between cognitive load and action-proportion for both misses and false alarms (see Table 2). The interaction was largely due to the low (vs. high) load condition revealing greater differences between the high and low-action-target proportion conditions, for both misses and false alarms. Overall, these findings supported the hypothesis that the load condition

acted like the higher proportion of action target conditions, with both leading to performance errors. Importantly, Table 2 also shows that these findings could not be attributed to a ceiling effect, both because the mean proportions in the high-action-target proportions are far from the upper limit of 1 and because the variances across conditions were almost identical.

Experiment 4: Benefits of Shifting Towards an Inaction Focus

Experiment 4 included a focus of attention on action, a focus of attention on inaction, and control conditions. These conditions were manipulated between subjects. Inducing a focus on action should resemble spontaneous conditions and thus not differ from the no-focus control condition. In contrast, inducing a focus on inaction may be expected to reduce or even reverse the difference in the previously observed effect of the action-proportion. Thus the inaction focus may either override a chronic focus on action, weaken that focus, or render it redundant, but any case should result in a significant interaction between focus and action-target proportion, with differential impact of action-target proportion across focus conditions.

Methods

Participants and design—A total of 148 undergraduates participated in the experiment in exchange for course credit ($M_{\text{age}} = 19.1$, $SD_{\text{age}} = .12$; 59% female). We calculated an N of 132 to detect a within-subjects interaction $d = .20$ with an alpha of .05 and 95% power. Based on typical attendance we scheduled a larger sample of 160, and obtained 148 during the time period of the experiment. The design was a 2 within-subjects action proportion (high: 75% vs. low: 25%) x a 3 within-subjects focus condition (action, control, inaction).

Procedure—As in Experiment 2 and the low-load conditions in Experiment 3, there were only four target words. To replicate our findings in conditions of lower error rates, we increased the response window from 400ms to 500ms, and introduced focus as another within-subjects factor, with three levels (action-focus, inaction-focus, control condition) that were fully crossed with the action-proportion manipulation used before.

Focus manipulation—In the action-focus condition, the instructions only mentioned the action-target word or words and told participants to press the spacebar when this/these word/words appeared. The instructions also described not pressing any keys when any other one word/three words appeared, but the exact words were not specified. In the inaction-focus condition, the instructions only mentioned the inaction-target word or words and told the participants not to press any keys when this/these word/words appeared and to press the spacebar when the other, non-described, one word/three words appeared. In the control condition, all the action and inaction words were mentioned as in the previous experiments. The six cells of the experiment design were counterbalanced across participants. Please see supplementary material for a description of the full procedures, instructions, and stimuli.

Results and Discussion

Misses and false alarms were separately submitted to a 2×3 repeated-measures ANOVA with action-proportion (high versus low) and focus (action-focus vs. control vs. inaction-focus) as two within-subject factors. Results are detailed in Table 3.

The analysis of misses revealed a significant interaction between the action-proportion and focus conditions. Replicating the previous experiments, in the control condition, misses and false alarms were higher in the high (vs. low) action-proportion condition (see Table 3). Suggesting that the control condition had an implicit action focus, the action-focus condition showed the same pattern of more errors in the high (vs. low) action-proportion condition (see Table 3). Across low and high action-proportion conditions, the rates of misses were higher in action or control focus conditions than inaction-focus conditions. These differences, however, were stronger in the low- (vs. high-) action-target proportion condition (see Table 3 for focused contrasts and main effects within the high- and low- action-target proportion conditions).

The analysis of false alarms also revealed a significant two-way interaction (see Table 3). Within the control and action-focus conditions, participants' false alarms were higher in the high action-proportion than in the low action-proportion condition. This finding thus supported the hypothesis that action was the default focus observed in the prior experiments and the control condition of this experiment. Moreover, in the low action-proportion conditions, according to the planned contrasts, the control and inaction-focus conditions had significantly more false alarms than the action-focus condition. There were no differences in focus within the high action-proportion condition, possibly due to a floor effect. Given that the high action-proportion condition is inherently a difficult situation due to a strong natural tendency to focus on the action demands, attempts at decreasing errors in this condition may prove less than effective.

General Discussion

People pursue both action and inaction goals, and the interplay between the two types of goals holds the key to a functional and healthy life in many life's domains. However, goal pursuit is difficult and error prone, and errors of performance are common. We asked several questions about the performance errors introduced by pursuing a greater number of action than inaction targets hypothesizing differential effects produced by differences in action/inaction focus. Specifically, the action-dominance error denotes the possibility that a greater number of action targets is more likely to undermine performance than a greater number of inaction targets. As modern societies put increasing emphasis on action (McCulloch et al., 2012), this emphasis may produce important consequences on the performance errors observed in multi-tasking contexts.

One important finding is also that the effects of frequency of Go and No Go responses over trials produced the predicted effect of prepotency: More false alarms and fewer misses when actions were frequent over trials but correspondingly less false alarms and more misses when inactions were frequent over trials. Note, however, that, Experiment 1 manipulated proportion of both targets and responses, whereas Experiments 2–4 only manipulated the

proportion of targets while keeping the responses constant at 50% Go and 50% No Go. The effect of the targets might have been similar to the effects of prepotency. Specifically, when inaction becomes the focus, it may either require inhibition of strong action tendencies to realize inaction goals or a re-focusing on opportunities not to act. However, this possibility should lead to more (less) frequent false alarms and fewer (more) misses when actions (inactions) were frequent over trials, which was not the case.

The results across four experiments revealed several fundamental properties of the simultaneous response to action and inaction demands (findings summarized Table). Experiments 1–3 showed that a higher proportion of action targets compared to inaction targets led to a higher number of false alarms (unwarranted action) and misses (failure to act). Experiment 3 replicated and extended the findings from Experiments 1–2 to reveal that the effect is at least partially due to cognitive overload, in that increasing cognitive load by raising the number of stimuli in a set is more disruptive in the low than the high-action-target proportion condition. Experiment 4 showed that people naturally focus their attention on action rather than inaction targets, but that a situationally-induced inaction focus can reduce the action dominance error.

The present investigation has taken the next step in investigating the effects of multiple behavioral demands, therefore adding to a prominent literature of multiple goal pursuit (Fishbach et al., 2009; A. Kruglanski et al., 2002). Based on our findings, organizations encouraging employees to assume more responsibilities may find that emphasizing what not to do is less taxing and leads to more effective performance. Specifically, Experiment 4 highlighted attention focus as an important factor, suggesting that that when the proportion of action targets is high, a shift in focus from action to inaction improves performance.

We offer a view on goals as responding to both action and inaction demands and take a first step at examining how people perform when having to respond to both action and inaction demands at the same time. Only a few studies consider inaction goals as comparable to action goals, or view those as goals people would find worthy of pursuit. Some studies have examined related notions of prevention goals (e.g. (Freitas, Liberman, & Higgins, 2002)) and avoidance-related goals (e.g. performance avoidance goals, (Elliot & Thrash, 2002), yet goals aimed at inaction are different from the active avoidance of performing badly or the active prevention of ‘ought to’ failures (see Footnote 1).

We must of course acknowledge that “inaction” may take many forms. For example, one may construe inactions as requiring self-control to resist a temptation (do not eat cake) in the service of meeting the action goal of eating healthy. An inaction demand in the service of a superordinate action goal presents interesting possibilities, including automatic greater attention to the inaction demand, a possibility outside the scope of this research. In relation to notions of self-control, an inaction goal may or may not involve inhibiting highly accessible concerns. When the focal goal is to relax, then the inaction endstate of being relaxed will require self-regulatory effort if the actor has a simultaneous goal to clean the house, but not otherwise. In this set of experiments, however, prepotency is defined as the proportion of Go and No Go responses required over trials, a common feature in GNG

experiments and manipulated only in Experiment 1. Critically, the prepotency of Go and No Go responses in Experiments 2 and on is 50/50, making the goal proportion and not prepotency the key manipulation. Further, in our paradigm, an inaction goal is not the same as inhibiting a prepotent action. Such a situation would occur if inaction goals and action goals were both present, such as waving to Jennifer (action goal) first but not waving to Jennifer (inaction goal) later. Future experiments would be needed to address this particular question.

Another interesting future direction would be to present an overarching action or inaction demand, such as being as friendly as possible or as private as possible. If, in addition to the goal to be as friendly as possible, participants receive the goal to not wave to 75% of the targets, those additional instructions should demand self-control. Thus, these inaction targets may trigger errors and error persistence effects if encountered later on in the task (Förster, Liberman, & Higgins, 2005; Goschke & Kuhl, 1993). Correspondingly, in addition to the goal to be as private as possible, people receive the goal to not wave to 75% of the targets, those additional instructions will catch attention much like in our inaction-focus conditions. In the current set of experiments, there is no overarching goal that would render inaction targets as either obstacles or facilitators to other goals.

The present findings complement findings on the general activation of action and inaction leading to behavior (Albarracín et al., 2008; Gendolla & Silvestrini, 2010; Noguchi, Handley, & Albarracín, 2011). In these studies, primes instill general action and inaction goals using incidental exposure to words cuing action and inaction such as *go* and *rest*. The mere exposure to action primes led to an activation of motor readiness leading to stronger physical and mental reactions (Gendolla & Silvestrini, 2010) and a wide array of unrelated action behaviors, such as doodling on a piece of paper, eating more, etc. (Albarracín et al., 2008; Albarracin et al., 2011; Hepler & Albarracin, 2014; Noguchi et al., 2011). Action words generally increased all outputs, whereas inaction words decreased action readiness and increased wanting to rest when rest was possible. The experiments in this paper extend these findings to show that a pattern of action and inaction demands creates errors not demonstrated in prior research.

Acknowledging the limitations of the GNG task, our methods are only suggestive of highly complex real-life situations of balancing action and inaction demands. The specific paradigm was purposely designed to provide simplified versions of reality to show the clearest evidence for the research question at hand. Future research could extend and generalize these findings to other settings, either extending the lab experiments to include more elaborate tasks or observing comparable effects in everyday-life cognition and behavior.

Conclusion

Life requires simultaneously attending to both action and inaction demands, and the consequences of chronic attention to these demands is only beginning to be understood. Our findings supported the hypothesis of an action dominance error, in which overemphasizing action can lead to error prone performance. These results thus demonstrate the importance of

further studying and understanding the cognitive processes and the behavioral implications of the human challenge of balancing action and inaction demands.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Experiment 2: Mean Proportion of Errors (SD) as a Function of Action-Target proportion

Table 1

	Misses	False alarms
	<i>Mp</i> (<i>SDp</i>)	<i>Mp</i> (<i>SDp</i>)
High action-target proportion	.36 (.02)	.14 (.02)
Low action-target proportion	.23 (.05)	.01 (.03)
<i>Paired t</i> (64)	4.95 ^{***}	11.76 ^{***}
<i>Cohen's d</i>	0.71	1.83

Note. Values are mean proportions, standard deviation in is parentheses. Proportions are calculated over the relevant trials. Trials were 50% go trials and 50% no go trials.

***.

p < .001

Experiment 3: Mean Proportions of Errors (SDs) as a Function of Action-Target Proportion in Combination with Cognitive Load

Table 2

	Misses			False alarms		
	High load <i>Mp</i> (<i>SDp</i>)	Low load <i>Mp</i> (<i>SDp</i>)	Difference <i>Mp</i> (<i>SDp</i>)	High load <i>Mp</i> (<i>SDp</i>)	Low load <i>Mp</i> (<i>SDp</i>)	Difference <i>Mp</i> (<i>SDp</i>)
High action-target proportion	.62 (.02)	.44 (.02)	.19***	.16 (.02)	.16 (.03)	0
Low action-target proportion	.49 (.02)	.24 (.03)	.25***	.04 (.02)	.02 (.02)	.02***
Difference	.13***	.21***	.13***	.13***	.14***	.14***
<i>F</i> Action-target proportion	53.36***	$\eta^2 = .83$	224.91***	$\eta^2 = 3.51$		
<i>F</i> Cognitive load	140.78***	$\eta^2 = 2.20$	11.24***	$\eta^2 = .18$		
<i>F</i> Interaction	8.84***	$\eta^2 = .14$	7.32***	$\eta^2 = .11$		
<i>df</i>	1, 64		1, 64			

Note. *Mp*: mean proportion of errors over relevant task trials; *SD*: standard deviation. Trials were 50% go trials and 50% no go trials. Differences were calculated by subtracting the second mean from the first, and stars represent the significance of the contrast.

***, $p < .001$. $\eta^2 = F(k-1)/(n-k)$

Table 3
 Experiment 4: Mean Proportions of Errors (SD) as a Function of Action-Target Proportion and Focus

	Misses						False alarms											
	Focus			Differences			Inaction			Control			Differences					
	Action	Inaction	Control	A-I	A-C	I-C	Mp (SDp)	Mp (SDp)	Mp (SDp)	A-I	A-C	I-C	Mp (SDp)	Mp (SDp)	Mp (SDp)	A-I	A-C	I-C
High action-target proportion	.21 (.05)	.17 (.03)	.21 (.04)	.04**	0	-.04*	.08 (.04)	.09 (.03)	.09 (.04)	-.01	-.01	0	.09 (.04)	.04 (.04)	.02 (.02)	-.02**	-.02***	0
Low action-target proportion	.03 (.03)	.25 (.04)	.03 (.04)	-.22***	0	.25***	.02 (.02)	.04 (.04)	.02 (.02)	-.02**	-.02**	0	.02 (.02)	.05***	.07***	-.02**	-.02***	0
Difference	.18***	-.08***	.18***				.06***											
Overall <i>F</i> Tests																		
<i>F</i> Action-target proportion	187.31***	$\eta^2 = 1.27$					141.58***	$\eta^2 = 0.96$										
<i>F</i> Focus	92.73***	$\eta^2 = 1.27$					4.79**	$\eta^2 = .07$										
<i>F</i> Interaction	136.54***	$\eta^2 = 1.87$					3.42*	$\eta^2 = .05$										
<i>df</i> action-target proportion	1, 147						1, 147											
<i>df</i> focus	2, 146						2, 146											
<i>df</i> interaction	2, 146						2, 146											
<i>F</i> Tests for Action-Target Proportion effects within Focus Conditions (<i>df</i> = 1, 147)																		
<i>F</i> within action focus	239.04***	$\eta^2 = 1.63$					21.57***	$\eta^2 = .15$										
<i>F</i> within inaction focus	105.52***	$\eta^2 = .72$					14.55***	$\eta^2 = .10$										
<i>F</i> within control focus	252.4***	$\eta^2 = 1.72$					33.81***	$\eta^2 = .23$										
<i>F</i> Tests for Focus Conditions within Action-Target Proportion Conditions (<i>df</i> = 2, 146)																		
<i>F</i> within high action-target proportion	3.12*	$\eta^2 = .04$					0.43	$\eta^2 = .01$										
<i>F</i> within low action-target proportion	222.32***	$\eta^2 = 3.05$					2.31	$\eta^2 = .03$										

Note. *Mp*: mean proportion of errors over relevant task trials; *SD*: standard deviation. Trials were 50% go trials and 50% no go trials. Differences were calculated by subtracting the second mean from the first, and stars represent the significance of the contrast.

*. $p < .05$. $p < .01$.

***. $p < .001$. $\eta^2 = F(k-1)/(n-k)$

Table 4

Summary of Findings

	N	IV1	IV2	Design	Main findings
Exp.1	78	Action-target proportion (high / low)	Action frequency proportion (high/low)	Stimuli: words 2x2 within	Higher action-target proportion: less accurate, more misses, more false alarms. Differs from pattern of frequently practiced behavior, which is more false alarms for more frequent go trials and more misses for more frequent no-go trials.
Exp. 2	65	Action-target proportion (high / low)		Stimuli: people 2 within	Higher action-target proportion: less accurate, more misses, more false alarms.
Exp. 3	65	Action-target proportion (high / low)	Cognitive load (high / low)	Stimuli: words 2x2 within	Higher action-target proportion: less accurate, more misses, more false alarms. Interaction: smaller action-target proportion effect when cognitive load is high for both misses and false alarms.
Exp. 4	148	Action-target proportion (high / low)	Attention focus (action, inaction, control)	Stimuli: words 2x3 within	Control condition similar to the action-focus condition. Action/control focus: Higher action-target proportion: less accurate, more misses, more false alarms. Inaction focus: reverse effect for misses, weakened effect for false alarms.