Personality and Social
Psychology Bulletin
1–13
© 2019 by the Society for Personality
and Social Psychology, Inc
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/0146167219855045
journals.sagepub.com/home/pspb
SAGE

Induced Social Power Improves Visual Working Memory

Britt Hadar[1], Roy Luria[1,2], and Nira Liberman[1]

Abstract

The possibility that social power improves working memory relative to conditions of powerlessness has been invoked to explain why manipulations of power improve performance in many cognitive tasks. Yet, whether power facilitates working memory performance has never been tested directly. In three studies, we induced high or low sense of power using the episodic recall task and tested participants' visual working memory capacity. We found that working memory capacity estimates were higher in the high-power than in the low-power condition in the standard change-detection task (Study 1), in a variation of the task that introduced distractors alongside the targets (Study 2), and in a variation that used real-world objects (Study 3). Studies 2 and 3 also tested whether high power improved working memory relative to low power by enhancing filtering efficiency, but did not find support for this hypothesis. We discuss implications for theories of both power and working memory.

Keywords

social power, visual working memory, cognitive performance, filtering

Received November 21, 2018; revision accepted May 4, 2019

Feeling powerful or powerless is a basic aspect of social life, and many individuals experience both feelings even within the same week (P. K. Smith & Hofmann, 2016). Power is defined as the asymmetric control or feeling of control over valuable resources by which one can influence others (Fiske, 2010; Galinsky, Rucker, & Magee, 2015; Keltner, Gruenfeld, & Anderson, 2003; Magee & Galinsky, 2008).

The experience of social power has been shown to change cognitive performance. Interestingly, while performance in some tasks seems to be hindered when one experiences herself or himself as powerful, performance in other tasks seems to improve. For example, inducing in participants a sense of high power compared with low power impeded emotion recognition (Nissan, Shapira, & Liberman, 2015), perspective taking (Galinsky, Magee, Inesi, & Gruenfeld, 2006), perceptual discrimination (Weick, Guinote, & Wilkinson, 2011), and increased various cognitive biases (Fiske, 1993), such as the planning fallacy (Weick & Guinote, 2008). On the contrary, experiencing high levels of power compared with low levels of power has also been found to improve executive control functions such as updating in the n-back task, inhibiting in the Stroop task, and planning in the Tower of Hanoi task (P. K. Smith, Jostmann, Galinsky, & van Dijk, 2008). Power relative to powerlessness also facilitated selective attention in the dichotic listening task (DeWall, Baumeister, Mead, & Vohs, 2011), in the Navon task (Guinote, 2007b), in the Flanker task (Schmid, Kleiman, & Amodio, 2015), and facilitated math calculations (Harada, Bridge, & Chiao, 2013), mental rotation (Nissan et al., 2015), and multitasking (Cai & Guinote, 2017). For example, Nissan et al. (2015) examined how power affected mental rotation. Participants had to indicate which one of the four alternative figures is a rotated version of a target figure. Presumably, to do so, participants have to mentally manipulate the visual image of the target figure (Hyun & Luck, 2007; Prime & Jolicoeur, 2010). Nissan et al. (2015) found that high-power participants scored higher on that test than low-power participants.

An important question that these results raise is whether these various effects of power are mediated by its effect on a basic cognitive capacity that underlies performance in many of those tasks. One possibility that has been often invoked in the literature is that an experience of high power (relative to low power) improves working memory (Cai & Guinote, 2017). For example, P. K. Smith et al. (2008, Study 4) showed that in a Stroop task that had only incongruent trials, in which active maintenance of a task goal is not required for successful performance, inducing a sense of high power did not

---

[1] Tel Aviv University, Israel
[2] Sagol School of Neuroscience, Tel-Aviv University, Israel

Corresponding Author:
Nira Liberman, School of Psychological Sciences, Tel Aviv University, P.O.B. 39040, Tel Aviv, 69978, Israel.
Email: niralib@tauex.tau.ac.il

affect performance. In contrast, in a Stroop task that had mostly congruent trials, in which the goal had to be kept in working memory, high-power participants performed better than the low-power participants. Although working memory is a likely explanation of these results, we thought that it would be important to test more directly the effect of power on working memory.

Two theories of why and how power affects cognitive performance are relevant. The first is the approach/inhibition theory of power (Keltner et al., 2003), which suggests that high power is associated with rewards and approaching opportunities whereas low power is associated with threats and avoiding punishments. The state of elevated threats leads the powerless to more carefully monitor their environment and to inhibit their behavior. It is further assumed that monitoring the environment is taxing on working memory. For example, if a student knows that his or her performance is evaluated by his or her advisor, then his or her working memory storage does not only hold the information needed for advancing the next argument in the paper, but also the thought of what the advisor might think about his or her work (for a similar argument about the effect of scarcity of resources, see, Mani, Mullainathan, Shafir, & Zhao, 2013; Shah, Mullainathan, & Shafir, 2012).

The second relevant theory is social distance theory of power (Magee & Smith, 2013), which suggests that high power is associated with the experience of social distance from other people, and therefore, leads to higher level, more abstract processing of information (Liberman & Trope, 2008; Shapira, Liberman, Trope, & Rim, 2012; Trope & Liberman, 2010). According to this view, abstract processing involves representing input by its central attributes, while ignoring peripheral, goal-irrelevant attributes. From this perspective, focusing on a primary goal and avoiding temptations/distractions is a process of abstraction (for a similar argument see, (Fujita & Carnevale, 2012; Fujita, Trope, Liberman, & Levin-Sagi, 2006; P. K. Smith et al., 2008), and hence, high-power individuals are expected to perform better at any task that requires attending to a goal in face of distractions. A similar prediction follows from the "situated focus" theory of power (Guinote, 2007a), according to which high-power individuals are better at focusing their attention on the current goal, while low-power individuals' attention is more equally distributed between focal and peripheral information. Both of these theories would also predict that power would facilitate filtering out irrelevant distractors, and hence would particularly help working memory in arrays that present both targets and distractors.

We chose to focus on visual working memory (VWM), which is a cognitive system that stores a limited amount of visual information in an active state, to serve other cognitive processes (Awh, Barton, & Vogel, 2007; Luck & Vogel, 2013). VWM plays a central role in almost any cognitive task that requires holding multiple visual items of dynamically changing information. Measures of VWM capacity have been found to correlate highly with measures of intelligence, academic aptitude, and general cognitive performance (Alloway & Alloway, 2010; Conway, Kane, & Engle, 2003; Cowan et al., 2005; Fukuda, Vogel, Mayr, & Awh, 2010; Shipstead, Redick, Hicks, & Engle, 2012).

Working memory is limited to around three to four objects (Cowan, 2001; Luck & Vogel, 1997), which makes it necessary to have an efficient mechanism to select only the relevant information and prevent irrelevant information from consuming that limited space. Indeed, a recent approach to VWM has proposed that an attentional filtering mechanism accounts for individual differences in VWM. According to this view, individuals with higher capacity do not have more storage space or representational resources, but instead they are more efficient in encoding relevant information while filtering out irrelevant information and/or information that exceeds capacity (Awh & Vogel, 2008; Cowan et al., 2005; Fukuda, Woodman, & Vogel, 2015; Vogel & Machizawa, 2004; Vogel, McCollough, & Machizawa, 2005). Consistent with this view, recent findings show that differences in VWM capacity are related to distractor suppression activity in visual cortex, such that high-capacity individuals compared with low-capacity individuals showed more suppression activity in the visual cortex (Gaspar, Christie, Prime, Jolicœur, & McDonald, 2016; Gulbinaite, Johnson, de Jong, Morey, & van Rijn, 2014).

A standard paradigm that is used to estimate the capacity of VWM is the change detection task (for a review see, Luck & Vogel, 2013). In this task, participants are briefly presented with an array of objects and are asked to hold these objects through a short interval after which their memory is probed. Based on performance, the K_{max} parameter is calculated, which represents the maximal number of items a given individual can store simultaneously.

In the present set of studies, we examined whether situationally induced sense of power would enhance performance of VWM, possibly by facilitating the filtering process. We tested our hypotheses in three studies, all of which manipulated power via the episodic recall task developed by Galinsky, Gruenfeld, and Magee (2003). In Study 1, we measured VWM capacity with the standard change detection task (Luck & Vogel, 1997). Study 2 was set to test the filtering hypothesis more directly using the change detection task with an additional condition that introduced distractors (that participants did not need to remember) alongside the targets (that participants had to remember). In Study 3, we used a variant of the change detection task with real-world objects and a word-stem-completion task to implicitly probe attention to distractors. We hypothesized that high power will increase VWM capacity estimates compared with low power (Studies 1-3) and that this difference will be related to better filtering (Studies 2 and 3).

Study 1

Study 1 examined the hypothesis that individuals who have been induced to experience high social power would exhibit better VWM performance relative to individuals who have been induced to experience low social power. This study also included a control condition, which aimed to explore an additional question, namely, whether high power helps VWM performance, low power hinders it, or both. We did not have an a priori hypothesis regarding this question.

Method

Participants. One hundred forty-nine undergraduate students (73 women, M_{age} = 23.60, *SD* = 3.16) participated in the study for course credit. Two participants were excluded from analysis because they reported inability to recall the appropriate experience in the priming task. All participants reported normal or corrected-to-normal visual acuity and normal color vision and were native Hebrew speakers. We did not have an estimate of the effect, but planned to be able to detect an effect of medium size with a probability of 0.85, for which a minimum of 178 participants was required. Aiming to meet this goal, data collection continued until the end of the semester.

Power priming. Participants first underwent a Hebrew version of the power priming procedure originally developed by Galinsky et al. (2003, see supplementary material). Participants were asked to recall and write about a personal event in which they had control over others (in the high-power condition) or an event in which they were controlled by others (in the low-power condition). Participants in the control condition wrote the schedule of their previous day.

Change detection task. Working memory capacity was measured via the change detection task (Luck & Vogel, 1997; Luria & Vogel, 2011). Each trial in the task started with the presentation of a fixation point ("+") in the middle of the screen for 500 milliseconds (ms) Then an array of four- or eight-colored squares appeared for 150 ms. After a 900-ms-long retention interval, one square appeared at one of the previous locations until response. Participants indicated whether the color of the square is the same as or different from the square presented in the same location in the sample array (see Figure 1 for an illustration). The task consisted of 20 practice trials with no feedback, and 60 trials for each array size (four vs. eight squares, 120 in total). The two types of trials were intermixed in random order, and half of them presented the same target and the other half presented a different target. Same and different trials were also intermixed in random order. Each square appeared at approximately $1.2^{o} \times 1.2^{o}$ of visual angle and was randomly positioned within a $20^{o} \times 20^{o}$ region upon a gray background. Minimal distance between each two stimuli was 2.1^{o}. The color of each square was randomly selected with no repetition (within an array) from a set of nine highly discriminable colors: black, blue, brown, cyan, green, orange, pink, red, and yellow. On changed trials, the original color was replaced with a color that was not presented in the sample array. VWM capacity estimate, K_{max}, was computed separately for each array size (four items, eight items). These two values were averaged to form a single parameter with a standard formula (Cowan, 2001), $K_{max} = S(H–F)$, where *S* is the size of the array, *H* is the observed hit rate (i.e., the proportion of correct answers in trials that presented a change), and *F* is the observed false alarm rate (i.e., the proportion of errors in trials that did not present a change). It is important to note that this formula takes into account the guessing rate and thus should (theoretically) result in the same K_{max} score regardless of set size.

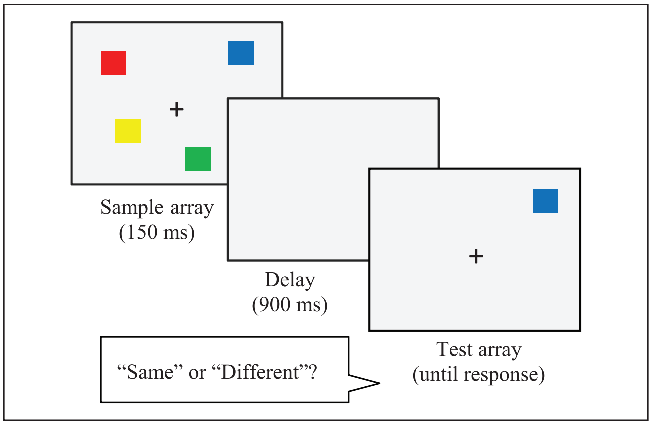

Figure 1. Illustration of the change detection task.
A sample array is presented for 150 ms and is followed by a retention interval of 900 ms during which a blank screen is presented. A test stimulus then appears and stays until response. The test stimulus is either identical to the sample array or different from it in color. Participants respond "same" or "different."

Manipulation check[1]. Participants' essays in the low-power and high-power conditions were coded by two condition-blind coders to determine the effectiveness of the manipulation. Content of the essays was scored on two separate scales of "powerfulness" and "powerlessness" that ranged from 1 *not at all* to 5 *very much*. We measured interrater reliability for the first 30 essays. Reliability was relatively high for both scales (powerfulness $r = .78$; powerlessness, $r = .84$). Therefore, the remaining essays were coded by a single coder who was blind to the condition. As correlation between the two scales (powerfulness and powerlessness) was high (–.88), we combined the two scores into a single score reflecting powerfulness (with powerlessness reversed coded).

Mood. Mood was assessed with the positive and negative affect schedule (PANAS; Watson, Clark, & Tellegen, 1988). Participants were asked to rate the extent to which they felt 10 positive emotions (e.g., proud) and 10 negative emotions (e.g., distressed) *"right now* at the present moment." Ratings were made on a 5-point scale, ranging from 1 *very slightly or not at all* to 5 *extremely.*

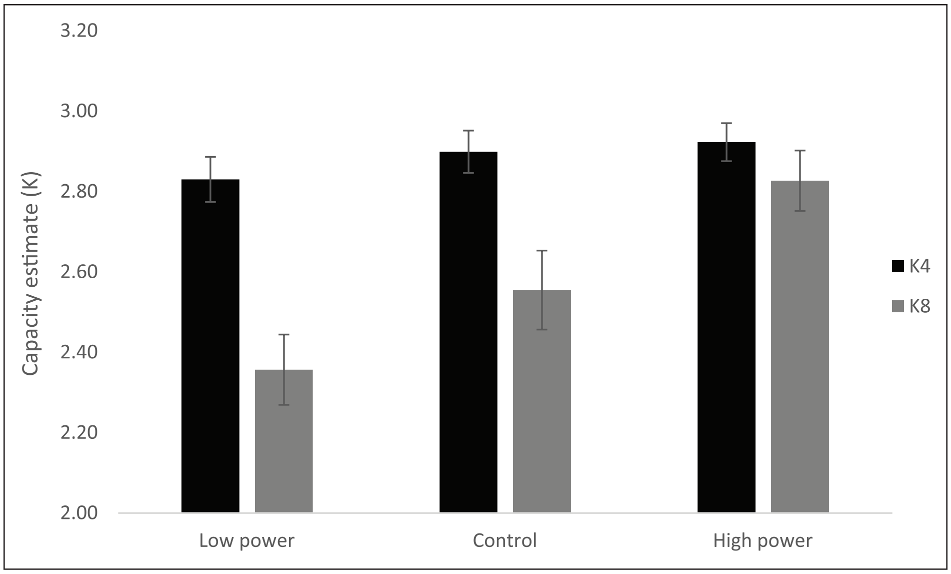

Figure 2. Working memory capacity K_{max} by condition and array size.
Error bars indicate standard errors.

Procedure. Participants were randomly assigned to either a high power, low power, or control conditions. They had five minutes to complete the power manipulation, which was followed by the change detection task. At the end of the session, participants completed the personal sense of power scale, a mood questionnaire and provided demographic information.

Results and Discussion

Manipulation check. One-way analysis of variance (ANOVA) revealed that essays in the high-power condition reflected more power ($M = 8.84$, $SD = 1.01$) than essays in the low-power condition ($M = 2.87$, $SD = .96$), $F(1, 95) = 890.45$, $p < .001$, $\eta_p^2 = .90$. The personal sense of power scale, however, did not reflect any difference in sense of power between high and low power, $F < 1$, possibly due to the long delay between the manipulation and the measure.

Working memory capacity. To test our central prediction, VWM estimate K_{max} was submitted to a 2 (array: four vs. eight) × 2 (power condition: low vs. high) mixed design ANOVA with array size as a within-participants variable. Analysis revealed that as predicted, K_{max} in the high-power condition ($M = 2.87$, $SD = .62$) was higher than in the low-power condition ($M = 2.59$, $SD = .75$), $F(1, 97) = 4.17$, $p = .044$, $\eta_p^2 = .041$, 95% confidence interval (CI) = [.004, .804] (Figure 2). A main effect of array size also emerged, such that K_{max} for four items ($M = 2.88$, $SD = .63$) was higher than K_{max} for eight items ($M = 2.59$, $SD = 1.02$), $F(1, 97) = 14.82$, $p = .004$, $\eta_p^2 = .082$. The interaction between power and array size was marginally significant, $F(1, 97) = 3.78$, $p = .055$, $\eta_p^2 = .038$. Further analyses showed that power had a greater effect on K_{max} in the eight items array $F(1, 146) = 5.45$, $p = .011$, $\eta_p^2 = .053$, than in the four items array, $F < 1$. To examine our exploratory question of whether high power improved performance or rather low power hindered it, we conducted planned comparisons of the control condition to the high-power condition and the low-power condition. Neither of these comparisons revealed a significant difference $F(1, 146) = 1.65$, $p = .201$, and $F(1, 146) =.44$, $p = .506$, respectively.

Mood. The power conditions did not differ in either positive affect, $F(1, 76) = 2.84$, $p = .10$, $\eta_p^2 = .04$, or negative affect, $F(1, 76) = .35$, $p = .56$, $\eta_p^2 = .01$.

In Study 1, individuals who were induced to experience a high sense of power obtained higher K_{max} scores compared with individuals who were induced to experience a low sense of power. Notably, this difference was driven by the large (eight items) arrays, rather than by small (four items) arrays. The difference between K_{max} estimates with eight-item versus four-item arrays is usually understood as indicating filtering deficiency (Fukuda et al., 2015). This is because this difference cannot be accounted for by capacity differences, because capacity is typically lower than four items (and the K_{max} score corrects for guessing probability). For example, if one is able to hold in memory three items, then she or he should be able to hold the same number of items regardless of array size. However, if one is distracted by the excessive information, then performance on the large arrays should be impaired compared with the small arrays. According to this account, the preferable strategy in the change detection task (and especially in the large arrays) is to select a subset of items and focus on them instead of trying to remember additional items, which may interfere with already stored items. Studies 2 and 3 were designed to test, in addition to the main hypothesis about the enhancing effect of power on VWM performance, whether power also increases filtering efficiency.

Study 1 also examined whether high power facilitates VWM or rather low power hinders it by including a control condition. In our sample, however, performance in the control condition did not significantly differ from performance in either the high-power or the low-power condition. Apparently, much more statistical power is needed to answer this question. In Studies 2 and 3, we, therefore, decided to focus on the prediction concerning high versus low power.

Study 2

Study 2 explored the hypothesis that the superior VWM performance with large arrays in the high-power condition reflects better filtering. If power promoted the ability to select a subset of items in the to-be-remembered-array and ignore items that exceed the capacity limit, then we should observe not only better memory, but also more efficient filtering in the high-power condition compared with the low-power condition. To measure filtering efficiency, we used a variant of the change detection task in which a filtering condition is added, such that both targets and distractors are presented simultaneously (Allon & Luria, 2017; Vogel et al., 2005). We hypothesized that participants in the high-power condition will (a) exhibit overall higher K_{max} (b) exhibit more efficient filtering (i.e., increased performance in arrays that present both targets and distractors) compared with individuals in the low-power condition.

Method

Participants. One hundred one undergraduate students (76 women; M_{age} = 22.87, *SD* = 2.22) participated in this study for course credit. One participant was excluded from analysis because he refused to complete the manipulation. All participants reported normal or corrected-to-normal visual acuity and normal color vision.

Filtering task. Each trial in the task started with the presentation of a fixation cross ("+") in the middle of the screen for 500 ms. Then, either three targets, six targets, or a display of three targets and three distractors (i.e., the filtering condition) was presented. Colored pacmans served as targets and circles served as distractors (Figure 3), such that the relevant dimension for filtering in this task was shape. The color of each stimulus was randomly selected with no repetition per array from a set of eight colors: black, blue, cyan, green, pink, red, white, and yellow and was presented on a gray background. All stimuli were randomly positioned within a 18° × 18° region on the monitor with the constrain that the minimal distance between each two stimuli was 2.7° of visual angle (center to center). On trials in which the test probe was different than the original array, the changed item was replaced with a color not presented in the sample array. Stimuli were presented for 200 ms and were followed by a retention interval of 900 ms during which a blank screen was presented. A test probe then appeared in one of the pervious target locations, and participants indicated whether the test probe had the same or a different color than the target color that appeared at that location. Participants preformed 10 practice trials with feedback and 360 critical trials with no feedback in three blocks of 120 trials each, with all three array types (three targets, six targets, three targets and three distractors) intermixed in random order.

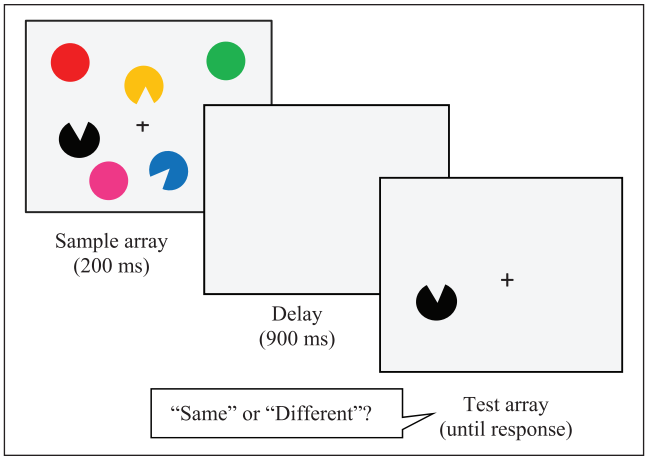

Figure 3. Illustration of the filtering task with an array of three targets and three distractors.
A sample array is followed by a blank delay and then a test array. The test array is either identical to the sample array or differs in the color of one of the targets. Arrays contained three targets, six targets, or three targets and three distractors (shown here). Participants are asked to ignore the distractors (circles) and indicate whether a change is present in one of the targets (pacmans).

Two complementing measures were used to estimate filtering efficiency. *Filtering cost* was calculated as the difference in accuracy between the three targets array and the filtering array (three targets and three distractors condition). A score near zero indicates perfect filtering, such that performance is not affected by distractors. Higher score, in contrast, indicates that distractors were consuming VWM capacity. *Filtering benefit* was calculated as the difference in accuracy between the filtering array and the six-target array. A higher score indicates better performance when some items in an array are designated as distractors compared with a similar-size array with targets only. A score near zero indicates no advantage to designating some of the stimuli in an array as distractors. In addition, to estimate VWM capacity, accuracy for each individual in the three- and six-target arrays was transformed into a K_{max} estimates as used in Study 1.

Task perceptions and mood. Participants were asked to rate the extent to which they felt "positive emotions" and "stress" right now. They were also asked to indicate their level of control ("how in control do you feel?") and level of motivation

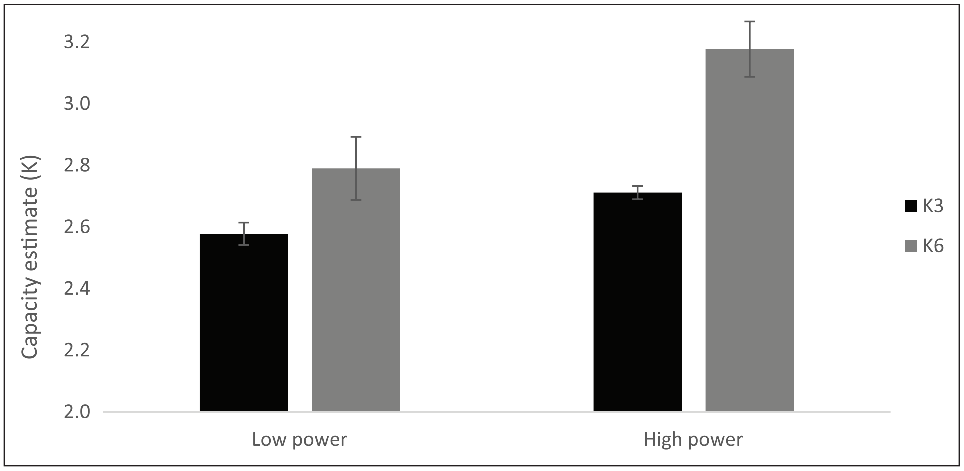

Figure 4. Capacity estimate K_{max} for each array size by power condition.
Error bars indicate standard error.

Table 1. Mean Accuracy and Standard Deviations (In Parentheses) for Each Array by Power Condition.

	Three targets	Three targets, three distractors	Six targets
Low power	0.93 (0.06)	0.77 (0.09)	0.73 (0.08)
High power	0.95 (0.03)	0.81 (0.08)	0.76 (0.07)

("how important was it for you to succeed in the memory task?"). Ratings were made on visual analog slider scales ranging from 0 *not at all* to 100 *very much*.

Procedure. Participants were randomly assigned to either a high-power or a low-power condition. Participants first completed 10 practice trials of the working memory task. They then completed the power manipulation, which was the same as in Study 1, followed by the working memory task. Finally, they completed a questionnaire that assessed mood and demographic information.

Results and Discussion

Working memory capacity. VWM estimate K_{max} was submitted to a 2 (array: three vs. six) × 2 (power condition: low vs. high) mixed design ANOVA, with array as a within-participants factor. The analysis revealed the predicted main effect of power, such that K_{max} in the high-power condition was higher ($M = 2.94$, $SD = .51$) than in the low-power condition ($M = 2.68$, $SD = .64$), $F(1, 98) = 4.99$, $p = .026$, $\eta_p^2 = .048$, 95% CI = [.039, .840]. Moreover, a significant effect for array size indicated that K_{max} for six items ($M = 2.98$, $SD = .97$) was higher than K_{max} for three items ($M = 2.64$, $SD = .31$), $F(1, 98) = 17.24$, $p < .001$, $\eta_p^2 = .150$. The interaction between array size and power was not significant, $F(1, 98) = 2.40$, $p = .124$. Power affected both the large arrays, $F(1, 98) = 4.06$, $p = .047$, $\eta_p^2 = .040$, and the small arrays $F(1, 98) = 4.95$, $p = .028$, $\eta_p^2 = .048$. Figure 4 presents these results.

Filtering efficiency

Filtering cost. The difference in accuracy between the three targets array and the filtering array was submitted to one-way ANOVA with power (high vs. low) as a between-participants factor. Contrary to our prediction, cost was not affected by power, $F(1, 98) = .509$, $p = .477$.

Filtering benefit. The difference in accuracy between the filtering array and the six-target array was submitted to the same analysis and likewise did not yield a significant difference between the two power conditions, $F(1, 98) = .449$, $p = .505$. Accuracy for each array is presented in Table 1.

Task perceptions and mood. The power conditions did not differ in either positive affect, $F(1, 98) = 0.47$, $p = .49$, $\eta_p^2 = .005$, stress, $F(1, 98) = 1.37$, $p = .24$, $\eta_p^2 = .016$, motivation $F(1, 98) = 1.78$, $p = .18$, $\eta_p^2 = .018$, and control $F(1, 97) = 1.67$, $p = .20$, $\eta_p^2 = .017$.

Study 2 showed improved VWM capacity for individuals induced to feel high sense of power compared with individuals induced to feel low sense of power, replicating the findings of Study 1. However, contrary to our prediction, we did not find any support for the filtering hypothesis, as we did not find any difference between conditions in the filtering cost scores or the filtering benefit scores. Study 3 was designed to test the same two hypotheses as Study 2 with a slightly different paradigm of assessing VWM and filtering efficiency.

Study 3

Study 3 was designed to (a) replicate the findings of Studies 1 and 2 that power enhances VWM performance and (b) examine whether power affects filtering efficiency. We used the standard change detection task (as in Study 1) with real-world objects instead of colored shapes (for a similar method see, Brady, Störmer, & Alvarez, 2016). In this study, we also assessed filtering by probing the semantic content of memory representations. On each trial of the change detection task, only the bottom or the top half of the screen was defined as relevant. On half of the trials, a "phonological pair" was presented, in which pictures of two objects whose names began or ended with the same syllable were presented simultaneously, one on the relevant side of the screen and one on the irrelevant side of the screen (e.g., a picture of a tower and a picture of a towel). We assessed memory for the irrelevant information, implicitly, using a word-stem-completion task (Graf, Mandler, & Haden, 1982; Warrington & Weiskrantz, 1970), which was introduced after each trial of the memory task. Implicit memory paradigms have shown that participants who have been exposed to pictures in the acquisition phase use the corresponding words in an ostensibly unrelated word-stem completion task. We hypothesized that deficient filtering would be associated with looking at distractors, and with using their names in the word-stem completion task. We, therefore, predicted that under conditions of low power, participants will name more distractors than under conditions of high power.

Method

Participants. One hundred undergraduate students (70 women, $M_{age} = 24.18$, $SD = 2.57$) took part in the study and were paid 40 NIS (around US$10) per hour for participation. Participants were native Hebrew speakers and reported normal hearing acuity[2] (for phonological awareness) and normal or corrected-to-normal visual acuity and normal color vision. Three participants did not complete the word-stem task, so only their change detection trials were analyzed.

Change detection task. Working memory capacity was measured via the change detection task, similar to Study 1, but with real-world objects instead of colored squares (see Brady et al., 2016). Each trial started with the presentation of a fixation cross ("+") in the middle of the screen for 500 ms, accompanied by an arrow pointing up or down, posited 12 pixels above or below it. Half of the trials presented an arrow pointing up ("↑") and half an arrow pointing down ("↓"). Participants were instructed to attend and remember only the stimuli presented on the side of the display to which the arrow pointed. Stimuli appeared for 900 ms, after which a 900-ms-long retention interval followed and then one object appeared at one of the previous locations on the cued side of the screen until response. Participants indicated whether the object is the same as or different from the object presented in the same location in the sample array. Half of the trials presented a different object and half presented the same object, intermixed in random order.

Each object appeared at approximately $1.2^{o} \times 1.2^{o}$ of visual angle and was randomly positioned within a $20^{o} \times 20^{o}$ region upon a white background. Minimal distance between each two stimuli was 2.1^{o}. Objects were randomly selected from the pool of objects with no repetition with the only exception that the phonological pairs were preassigned to appear together (target and distractor were counterbalanced, such that each object has the same likelihood to be presented in the relevant versus the irrelevant side of the display). The task consisted of six practice trials, and 16 trials for each set size (four or eight objects), 32 trials in total.

Stimuli. Objects were selected from a set of 384 highly discriminable objects drawn from the normed color image set of Rossion and Pourtois (2004). The remaining images were taken from commercial clip art databases and were selected to match the Rossion and Pourtois (2004) images in visual style. Half of the trials presented objects with no phonological relation and half presented a phonological pair that overlapped in either the initial syllable (e.g., tower and towel) or the last syllable (e.g., corn and horn). The phonological pairs were validated in previous research (Hadar, Skrzypek, Wingfield, & Ben-David, 2016), equated for recognizability, familiarity, frequency in Hebrew, and salience. All the phonological pairs were disyllabic.

Word-stem-completion task. After each trial of the change detection task, participants were presented with a word-stem in which the first (or last) two to three letters were shown and the next (or preceding) two to three letters were left blank (e.g., *t* o _ _ _ or _ _ r n) for the participant to complete with the first word that came to their mind. Critically, 50% of the trials provided a word that could be completed with pictures presented in the change detection task (e.g., tower/towel or corn/horn). Figure 5 illustrates the sequence of events in each trial. For each participant, we subtracted the number of word-stems that were completed with distractor words from the number of word-stems that were completed with target words. Higher scores indicate more attention to targets and less attention to distractors.

Task perceptions and mood. Participants indicated how positive they feel right now, their current levels of stress and motivation, and how "in control" they feel (same as in Study 2). We also asked how difficult for them was to remember and write about the personal event in the power manipulation.[3] All responses were made on visual analog slider scales ranging from 0 *not at all* to 100 *very much*. In addition, participants were asked an open-ended question about any relation that they might have seen between the various stimuli in the experiment.

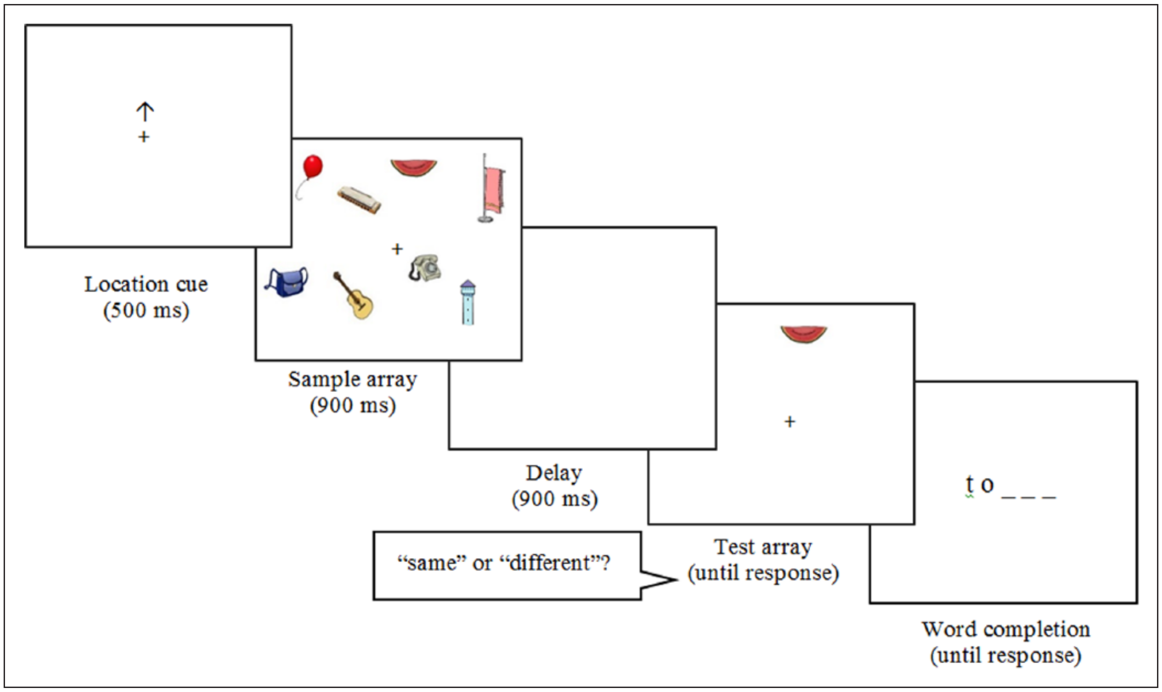

Figure 5. Illustration of the change detection task with word completion.
Arrow cued participants to attend to the relevant side of the screen (either above or below the fixation cross). Half of the trials contained a phonological pair (e.g., towel and tower) presented simultaneously on both sides of the screen. The other half of the trials did not present a phonological pair. After indicating "same" or "different" in the change detection task, participants completed the word-stem task (e.g., to_ _ _).

Procedure. Participants were randomly assigned to either a high-power or a low-power condition. Participants first completed six practice trials of the working memory task. They then completed the power manipulation, which was the same as in Studies 1 and 2, followed by the working memory task. Finally, they completed a questionnaire that assessed task perceptions, mood, and demographic information.

Results and Discussion

Working memory capacity. VWM estimate K_{max} was submitted to a 2 (array: four vs. eight) × 2 (power condition: low vs. high) mixed design ANOVA, with array as a within-participants factor. The analysis revealed the predicted main effect of power, such that K_{max} in the high-power condition was higher (M = 3.79, SD = .94) than in the low-power condition (M = 3.06, SD = 1.35), $F(1, 98) = 9.78$, $p = .002$, $\eta_p^2 = .091$, 95% CI = [.209, .993]. The effect of array size was also significant, such that K_{max} for 8 items was higher (M = 3.77, SD = 2.11) than K_{max} for four items (M = 3.08, SD = .82), $F(1, 98) = 12.89$, $p = .001$, $\eta_p^2 = .116$. The interaction of array size and power was significant, $F(1, 98) = 14.87$, $p < .0001$, $\eta_p^2 = .132$. A simple effect breakdown of the interaction showed that high power (relative to low power) enhanced VWM performance with arrays of eight items $F(1, 98) = 13.89$, $p < .0001$, $\eta_p^2 = .124$, but not with arrays of four items, $F < 1$ (Figure 6).

Word-stem-completion. Repeated measures ANOVA with 2 (type of word: target vs. distractor) × 2 (array size: four vs. eight) × 2 (power condition: high vs. low) with only the last variable as a between-participants factor revealed that contrary to our hypothesis, power did not have a significant effect, $F < 1$. The analyses also revealed a main effect of type of word, indicating that as might be expected, targets were completed more (M = 4.25, SD = 1.96) than distractors (M = 3.55, SD = 1.75), $F(1, 95) = 7.26$, $p = .008$, $\eta_p^2 = .070$. The effect of array was marginally significant, such that overall completion of targets and distractors was higher in the four items array (M = 4.17, SD = 1.41) than in the eight items array (M = 3.62, SD = 1.34), $F(1, 95) = 3.39$, $p = .069$, $\eta_p^2 = .034$. The interaction of power with type of word and with array size was not significant, $F(1, 95) = 2.14$, $p = .147$, and $F < 1$, respectively. The interaction of array size and type of word was not significant, although a trend emerged, $F(1, 95) = 2.80$, $p = .100$, $\eta_p^2 = .028$. A simple effect breakdown of this interaction showed that more target words were completed when targets were presented in four-item arrays than in eight-item arrays, $F(1, 95) = 4.74$, $p = .032$, $\eta_p^2 = .047$. However, distractor completion was not affected by array size, $F < 1$. The interaction of power, array size, and type of word was not significant, $F < 1$. These results are presented in Table 2.

Difference scores. We calculated the difference between target and distractor completion in the word-stem task. We

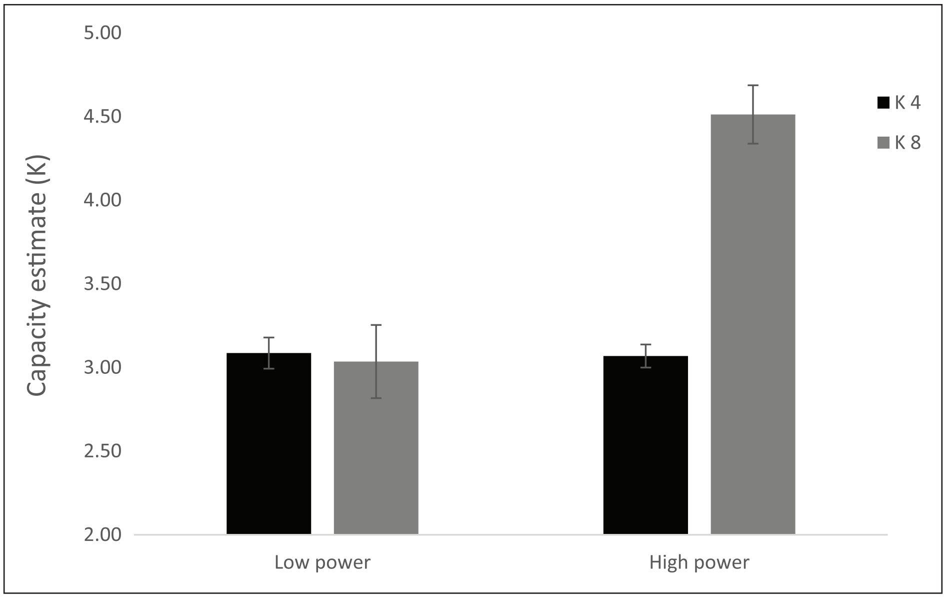

Figure 6. Working memory capacity estimate K_{max} by condition and array size.
Error bars indicate standard errors.

Table 2. Type of Word Completion for Each Array Size (in Percentages).

	Targets	Distractors	Words	Nonwords
Four-item arrays	32.63	24.58	66.90	5.11
Eight-item arrays	27.34	25.68	69.11	5.64

thought that this difference would reflect attending to the targets more than to the distractors. We examined the correlation between this difference score and capacity estimate K_{max}. We thought that attending to the targets more than to the distractors would correlate with K_{max}. However, contrary to our hypothesis, no such correlation was found, $r(97) = .101$, $p = .324$, suggesting the possibility that difference scores may not effectively capture filtering efficiency.

Task perceptions and mood. The measures of mood, stress, motivation, perceived difficulty of the task, and feeling "in control" did not differ between high- and low-power participants, all Fs < 1. None of the participants reported noticing the phonological competition between the stimuli in the relevant versus irrelevant locations. Moreover, only four participants (4% of the whole sample) reported noticing that the irrelevant location contained visual stimuli that could assist the word completion.

The present results replicated the findings of Studies 1 and 2, and extended them to a new set of stimuli, which were real-world objects rather than simple shapes. Interestingly, K_{max} in the current study was higher than that in Studies 1 and 2. This finding is consistent with previous research showing that capacity for real-world objects has a more flexible limit than that for simple objects (Brady et al., 2016; Endress & Potter, 2014). It is important to note that our aim was to compare working memory performance between high- and low-power conditions and not to investigate the nature of VWM capacity limits. The potential effects of long-term memory in facilitating memory for real-world objects should be similar between the two power groups. Thus, any difference between high and low power should be attributed to working memory performance.

One may ask whether the word-stem completion task reliably reflected filtering. On the one hand, more word stems were completed with words that denoted targets than with words that denoted distractors, indicating that word-stem completion is sensitive to the extent to which the corresponding pictures were attended. Moreover, targets were completed more in the small (four items) arrays compared with the large (eight items) arrays. This, too, suggests that word-stem completion was sensitive to extent of attention, as we can safely assume that objects received more attention in small than in large arrays. On the other hand, one key result did not obtain: VWM capacity estimate K_{max} did not correlate with the extent to which participants were more attentive to targets than to distractors (i.e., did not correlate with the difference scores: word-stems completed with targets minus word-stems completed with distractors). This casts doubt on whether word stem-completion indeed measured filtering.

Possibly, the overall low rate of completing the word stems with either targets or distractors made this task nondiagnostic with respect to the extent of representing targets versus distractors in memory.

General Discussion

In three studies, we manipulated sense of social power via an episodic recall task and measured VWM performance using different variations of the change detection task. Three studies supported our main prediction that a manipulation of high power compared with low power would result in higher working memory estimates.

In Study 1, participants performed the standard change detection task, which tested their memory of briefly presented colored shapes. As predicted, high-power participants had higher capacity estimates than low-power participants. This difference in performance stemmed from the large eight-item arrays, a pattern that is typically thought to indicate insufficient filtering of excessive information.

Study 2 examined both VWM capacity and filtering efficiency with a variant of the change detection task in which we introduced, on a subset of the trials, distractors alongside the targets. We again found that VWM capacity estimates were higher in the high-power compared with the low-power condition, but we did not find evidence of more efficient filtering in the high-power compared with the low-power condition. To generalize the findings to a different set of stimuli, in Study 3, we assessed VWM capacity for real-world objects. We found, as predicted, higher capacity estimates in the high-power compared with the low-power condition. Study 3 tested the filtering hypothesis again, using the word-stem-completion task, which implicitly probed extent of attending to the targets versus to the distractors. In this study, too, we did not find evidence of better filtering-out of distractors among the high-power participants compared with the low-power participants. In Study 3, the difference in capacity estimates between the power conditions was more pronounced in the large, eight-item arrays. The results of Study 1 also trended in that direction, but those of Study 2 did not. Taken together, these results clearly show that inducing in individuals a sense of high-power increases their VWM performance compared with low power, though the evidence regarding the involvement of a filtering process in this effect are inconclusive.

Power was found to affect performance on many cognitive tasks (e.g., Stroop, Flanker, Tower of Hanoi). However, the cognitive mechanism of these effects or the theoretical link between them was never tested directly. Possibly, tasks that have been shown to benefit from high power (compared with low power) rely on working memory and benefit from higher WM capacity. These include mental rotation (Hyun & Luck, 2007; Prime & Jolicoeur, 2010), multitasking (Colom, Martínez-Molina, Shih, & Santacreu, 2010), n-back (Cohen et al., 1997; Shamosh et al., 2008), Stroop (Kane & Engle, 2003; Long & Prat, 2002), Flanker (Pratt, Willoughby, & Swick, 2011), Tower of Hanoi (Welsh, Satterlee-Cartmell, & Stine, 1999; Zook, Davalos, DeLosh, & Davis, 2004), and dichotic listening (Engle, 2002). Our results thus support the possibility that WM mediates the effect of power on performance in these tasks. Although in this article, we do not conduct a full mediation analysis, we do test the effect of power on the assumed mediator, which is an important stage in establishing mediation. Together with the aforementioned findings on the effects of power on performance in these tasks, and in light of findings that WM capacity is related to performance on these tasks, our finding on the effect of power on WM completes the picture and suggests mediation. Future research should examine this mediation more directly.

By connecting power and working memory, we offer new perspectives on extant finding in the literature of power. For example, higher power has been found to be associated with lower levels of stress, as indicated by reduced physiological markers of stress and lower reports of anxiety (Rejeski, Gagne, Parker, & Koritnik, 1989; Schmid & Schmid Mast, 2013; Sherman et al., 2012). Our results raise the possibility that these effects might have to do with WM. Indeed, recent findings show that low WM capacity individuals are more susceptible to detrimental stress effects than high WM capacity individuals (Otto, Raio, Chiang, Phelps, & Daw, 2013). Similarly, Schmeichel and Demaree (2010) found that individuals with higher WM capacity were better at spontaneously regulating negative feedback and experienced less negative affect.

A dominant approach to working memory capacity views it as a stable individual characteristic rather than as malleable or contingent on specific context (Friedman et al., 2008; Johnson et al., 2013; Xu, Adam, Fang, & Vogel, 2017). Only a handful of papers demonstrated that performance on VWM tasks is affected by situational factors such as sleep deprivation (M. E. Smith, McEvoy, & Gevins, 2002), mood (Brose, Schmiedek, Lövdén, & Lindenberger, 2012), and instruction-induced strategies (Bengson & Luck, 2016). The present research is in line with this latter approach. Importantly, whereas previous research has focused on *cognitive factors*, our studies demonstrate the effect of *social factors*. We, therefore, not only support the malleable (as opposed to the fixed) view of working memory, but also emphasize the importance of social situations, namely, the experienced standing of an individual in terms of his or her social power.

More generally, working memory is a basic cognitive function involved in reasoning, planning, goal pursuit, and problem solving. Therefore, the finding that power affects VWM performance is of considerable importance that bears not only theoretical, but also practical implications in many applied settings. For example, an imposing environment (e.g., a large, dense and noisy building), in which negative events (e.g., bullying, punishments) occur unpredictably and important outcomes (e.g., grades, salary) are determined by other people (e.g., teachers, bosses) most likely induces a sense powerlessness. If experiencing powerlessness reduces

VWM even by a small degree, then it would be very consequential for how we structure our schools, work environments, and social relations.

Conclusion

Although never tested directly, improved working memory performance has been frequently suggested as the mechanism underlying the superior cognitive performance of the powerful (Cai & Guinote, 2017; Nissan et al., 2015 P. K. Smith et al., 2008). In this article, we provide direct evidence showing that sense of high power (compared with low power) increases working memory capacity estimates.

Our finding that working memory performance varies with experiences of social power sheds new light on working memory capacity theories, suggesting that it might not be as stable as previously thought, but might change from situation to situation, depending on how socially powerful one feels. These results are, therefore, of considerable importance for both the basic science of psychology and for applied psychological questions.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was supported by the Israel Science Foundation Grant No. 524/17 awarded to Nira Liberman and the Israel Science Foundation Grant No. 862/17 awarded to Roy Luria.

Notes

1. We also included the personal sense of power scale (Anderson, John, & Keltner, 2012), but it did not vary between conditions, possibly because it is designed to measure a stable sense of power (but see, Chen, Langner, & Mendoza-Denton, 2009; Fast, Sivanathan, Mayer, & Galinsky, 2012, who did find effects of experimental manipulations in this scale). We will not further analyze it.
2. One participant had hearing impairment, but including him in the analysis did not change the overall pattern.
3. This question was used to exploratory purposes and will not be included in the main analyses.

Supplemental Material

Supplemental material is available online with this article.

References

Allon, A. S., & Luria, R. (2017). Compensation mechanisms that improve distractor filtering are short-lived. *Cognition*, *164*, 74-86.

Alloway, T. P., & Alloway, R. G. (2010). Investigating the predictive roles of working memory and IQ in academic attainment. *Journal of Experimental Child Psychology*, *106*, 20-29.

Anderson, C., John, O. P., & Keltner, D. (2012). The personal sense of power. *Journal of Personality*, *80*, 313-344.

Awh, E., Barton, B., & Vogel, E. K. (2007). Visual working memory represents a fixed number of items regardless of complexity. *Psychological Science*, *18*, 622-628.

Awh, E., & Vogel, E. K. (2008). The bouncer in the brain. *Nature Neuroscience*, *11*, 5-6.

Bengson, J. J., & Luck, S. J. (2016). Effects of strategy on visual working memory capacity. *Psychonomic Bulletin & Review*, *23*, 265-270.

Brady, T. F., Störmer, V. S., & Alvarez, G. A. (2016). Working memory is not fixed-capacity: More active storage capacity for real-world objects than for simple stimuli. *Proceedings of the National Academy of Sciences of the United States of America*, *113*, 7459-7464.

Brose, A., Schmiedek, F., Lövdén, M., & Lindenberger, U. (2012). Daily variability in working memory is coupled with negative affect: The role of attention and motivation. *Emotion*, *12*, 605-617.

Cai, R. A., & Guinote, A. (2017). Doing many things at a time: Lack of power decreases the ability to multitask. *British Journal of Social Psychology*, *56*, 475-492.

Chen, S., Langner, C. A., & Mendoza-Denton, R. (2009). When dispositional and role power fit: Implications for self-expression and self–other congruence. *Journal of Personality and Social Psychology*, *96*, 710-727.

Cohen, J. D., Perlstein, W. M., Braver, T. S., Nystrom, L. E., Noll, D. C., Jonides, J., & Smith, E. E. (1997). Temporal dynamics of brain activation during a working memory task. *Nature*, *386*, 604-608.

Colom, R., Martínez-Molina, A., Shih, P. C., & Santacreu, J. (2010). Intelligence, working memory, and multitasking performance. *Intelligence*, *38*, 543-551.

Conway, A. R., Kane, M. J., & Engle, R. W. (2003). Working memory capacity and its relation to general intelligence. *Trends in Cognitive Sciences*, *7*, 547-552.

Cowan, N. (2001). Metatheory of storage capacity limits. *Behavioral and Brain Sciences*, *24*, 154-176.

Cowan, N., Elliott, E. M., Saults, J. S., Morey, C. C., Mattox, S., Hismjatullina, A., & Conway, A. R. (2005). On the capacity of attention: Its estimation and its role in working memory and cognitive aptitudes. *Cognitive Psychology*, *51*, 42-100.

DeWall, C. N., Baumeister, R. F., Mead, N. L., & Vohs, K. D. (2011). How leaders self-regulate their task performance: Evidence that power promotes diligence, depletion, and disdain. *Journal of Personality and Social Psychology*, *100*, 47-65.

Endress, A. D., & Potter, M. C. (2014). Large capacity temporary visual memory. *Journal of Experimental Psychology: General*, *143*, 548-565.

Engle, R. W. (2002). Working memory capacity as executive attention. *Current Directions in Psychological Science*, *11*, 19-23.

Fast, N. J., Sivanathan, N., Mayer, N. D., & Galinsky, A. D. (2012). Power and overconfident decision-making. *Organizational Behavior and Human Decision Processes*, *117*, 249-260.

Fiske, S. T. (1993). Controlling other people: The impact of power on stereotyping. *American Psychologist*, *48*, 621-628.

Fiske, S. T. (2010). Interpersonal stratification: Status, power, and subordination. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *Handbook of social psychology* (pp. 941-982). New York, NY: John Wiley.

Friedman, N. P., Miyake, A., Young, S. E., DeFries, J. C., Corley, R. P., & Hewitt, J. K. (2008). Individual differences in executive functions are almost entirely genetic in origin. *Journal of Experimental Psychology: General*, *137*, 201-225.

Fujita, K., & Carnevale, J. J. (2012). Transcending temptation through abstraction: The role of construal level in self-control. *Current Directions in Psychological Science*, *21*, 248-252.

Fujita, K., Trope, Y., Liberman, N., & Levin-Sagi, M. (2006). Construal levels and self-control. *Journal of Personality and Social Psychology*, *90*, 351-367.

Fukuda, K., Vogel, E., Mayr, U., & Awh, E. (2010). Quantity, not quality: The relationship between fluid intelligence and working memory capacity. *Psychonomic Bulletin & Review*, *17*, 673-679.

Fukuda, K., Woodman, G. F., & Vogel, E. K. (2015). Individual differences in visual working memory capacity: Contributions of attentional control to storage. In P. Jolicoeur, C. Fevebvre, & J. Martinez-Trujillo (Eds.), *Mechanisms of sensory working memory: Attention and performance XXV* (pp. 105-120). London, England: Academic Press.

Galinsky, A. D., Gruenfeld, D. H., & Magee, J. C. (2003). From power to action. *Journal of Personality and Social Psychology*, *85*, 453-466.

Galinsky, A. D., Magee, J. C., Inesi, M. E., & Gruenfeld, D. H. (2006). Power and perspectives not taken. *Psychological Science*, *17*, 1068-1074.

Galinsky, A. D., Rucker, D. D., & Magee, J. C. (2015). Power: Past findings, present considerations, and future directions. In P. R. S. M. Mikulincer (Ed.), *APA handbook of personality and social psychology* (pp. 421-460). Washington, DC: American Psychological Association.

Gaspar, J. M., Christie, G. J., Prime, D. J., Jolicœur, P., & McDonald, J. J. (2016). Inability to suppress salient distractors predicts low visual working memory capacity. *Proceedings of the National Academy of Sciences of the United States of America*, *113*, 3693-3698.

Graf, P., Mandler, G., & Haden, P. E. (1982). Simulating amnesic symptoms in normal subjects. *Science*, *218*, 1243-1244.

Guinote, A. (2007a). Behaviour variability and the situated focus theory of power. *European Review of Social Psychology*, *18*, 256-295.

Guinote, A. (2007b). Power affects basic cognition: Increased attentional inhibition and flexibility. *Journal of Experimental Social Psychology*, *43*, 685-697.

Gulbinaite, R., Johnson, A., de Jong, R., Morey, C. C., & van Rijn, H. (2014). Dissociable mechanisms underlying individual differences in visual working memory capacity. *NeuroImage*, *99*, 197-206.

Hadar, B., Skrzypek, J. E., Wingfield, A., & Ben-David, B. M. (2016). Working memory load affects processing time in spoken word recognition: Evidence from eye-movements. *Frontiers in Neuroscience*, *10*, Article 221.

Harada, T., Bridge, D., & Chiao, J. Y. (2013). Dynamic social power modulates neural basis of math calculation. *Frontiers in Human Neuroscience*, *6*, 115-127.

Hyun, J.-S., & Luck, S. J. (2007). Visual working memory as the substrate for mental rotation. *Psychonomic Bulletin & Review*, *14*, 154-158.

Johnson, M. K., McMahon, R. P., Robinson, B. M., Harvey, A. N., Hahn, B., Leonard, C. J., . . . Gold, J. M. (2013). The relationship between working memory capacity and broad measures of cognitive ability in healthy adults and people with schizophrenia. *Neuropsychology*, *27*, 220-229.

Kane, M. J., & Engle, R. W. (2003). Working-memory capacity and the control of attention: The contributions of goal neglect, response competition, and task set to Stroop interference. *Journal of Experimental Psychology: General*, *132*, 47-70.

Keltner, D., Gruenfeld, D. H., & Anderson, C. (2003). Power, approach, and inhibition. *Psychological Review*, *110*, 265-284.

Liberman, N., & Trope, Y. (2008). The psychology of transcending the here and now. *Science*, *322*, 1201-1205.

Long, D. L., & Prat, C. S. (2002). Working memory and Stroop interference: An individual differences investigation. *Memory & Cognition*, *30*, 294-301.

Luck, S. J., & Vogel, E. K. (1997). The capacity of visual working memory for features and conjunctions. *Nature*, *390*, 279-281.

Luck, S. J., & Vogel, E. K. (2013). Visual working memory capacity: From psychophysics and neurobiology to individual differences. *Trends in Cognitive Sciences*, *17*, 391-400.

Luria, R., & Vogel, E. K. (2011). Shape and color conjunction stimuli are represented as bound objects in visual working memory. *Neuropsychologia*, *49*, 1632-1639.

Magee, J. C., & Galinsky, A. D. (2008). 8 social hierarchy: The self-reinforcing nature of power and status. *The Academy of Management Annals*, *2*, 351-398.

Magee, J. C., & Smith, P. K. (2013). The social distance theory of power. *Personality and Social Psychology Review*, *17*, 158-186.

Mani, A., Mullainathan, S., Shafir, E., & Zhao, J. (2013). Poverty impedes cognitive function. *Science*, *341*, 976-980.

Nissan, T., Shapira, O., & Liberman, N. (2015). Effects of power on mental rotation and emotion recognition in women. *Personality and Social Psychology Bulletin*, *41*, 1425-1437.

Otto, A. R., Raio, C. M., Chiang, A., Phelps, E. A., & Daw, N. D. (2013). Working-memory capacity protects model-based learning from stress. *Proceedings of the National Academy of Sciences of the United States of America*, *110*, 20941-20946.

Pratt, N., Willoughby, A., & Swick, D. (2011). Effects of working memory load on visual selective attention: Behavioral and electrophysiological evidence. *Frontiers in Human Neuroscience*, *5*, Article 57.

Prime, D. J., & Jolicoeur, P. (2010). Mental rotation requires visual short-term memory: Evidence from human electric cortical activity. *Journal of Cognitive Neuroscience*, *22*, 2437-2446.

Rejeski, W. J., Gagne, M., Parker, P. E., & Koritnik, D. R. (1989). Acute stress reactivity from contested dominance in dominant and submissive males. *Behavioral Medicine*, *15*, 118-124.

Rossion, B., & Pourtois, G. (2004). Revisiting Snodgrass and Vanderwart's object pictorial set: The role of surface detail in basic-level object recognition. *Perception*, *33*, 217-236.

Schmeichel, B. J., & Demaree, H. A. (2010). Working memory capacity and spontaneous emotion regulation: High capacity predicts self-enhancement in response to negative feedback. *Emotion*, *10*, 739-744.

Schmid, P. C., Kleiman, T., & Amodio, D. M. (2015). Power effects on cognitive control: Turning conflict into action. *Journal of Experimental Psychology: General*, *144*, 655-663.

Schmid, P. C., & Schmid Mast, M. (2013). Power increases performance in a social evaluation situation as a result of decreased stress responses. *European Journal of Social Psychology*, *43*, 201-211.

Shah, A. K., Mullainathan, S., & Shafir, E. (2012). Some consequences of having too little. *Science*, *338*, 682-685.

Shamosh, N. A., DeYoung, C. G., Green, A. E., Reis, D. L., Johnson, M. R., Conway, A. R., . . . Gray, J. R. (2008). Individual differences in delay discounting: relation to intelligence, working memory, and anterior prefrontal cortex. *Psychological Science*, *19*, 904-911.

Shapira, O., Liberman, N., Trope, N., & Rim, S. (2012). Levels of mental construal. In S. Fiske & N. McRae (Eds.), *SAGE handbook of social cognition* (pp. 229-250). Thousand Oaks, CA: SAGE.

Sherman, G. D., Lee, J. J., Cuddy, A. J., Renshon, J., Oveis, C., Gross, J. J., & Lerner, J. S. (2012). Leadership is associated with lower levels of stress. *Proceedings of the National Academy of Sciences of the United States of America*, *109*, 17903-17907.

Shipstead, Z., Redick, T. S., Hicks, K. L., & Engle, R. W. (2012). The scope and control of attention as separate aspects of working memory. *Memory*, *20*, 608-628.

Smith, M. E., McEvoy, L. K., & Gevins, A. (2002). The impact of moderate sleep loss on neurophysiologic signals during working-memory task performance. *Sleep*, *25*, 56-66.

Smith, P. K., & Hofmann, W. (2016). Power in everyday life. *Proceedings of the National Academy of Sciences of the United States of America*, *113*, 10043-10048.

Smith, P. K., Jostmann, N. B., Galinsky, A. D., & van Dijk, W. W. (2008). Lacking power impairs executive functions. *Psychological Science*, *19*, 441-447.

Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological Review*, *117*, 440-463.

Vogel, E. K., & Machizawa, M. G. (2004). Neural activity predicts individual differences in visual working memory capacity. *Nature*, *428*, 748-751.

Vogel, E. K., McCollough, A. W., & Machizawa, M. G. (2005). Neural measures reveal individual differences in controlling access to working memory. *Nature*, *438*, 500-503.

Warrington, E. K., & Weiskrantz, L. (1970). Amnesic syndrome: Consolidation or retrieval? *Nature*, *228*, 628-630.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063-1070.

Weick, M., & Guinote, A. (2008). When subjective experiences matter: Power increases reliance on the ease of retrieval. *Journal of Personality and Social Psychology*, *94*, 956-970.

Weick, M., Guinote, A., & Wilkinson, D. (2011). Lack of power enhances visual perceptual discrimination. *Canadian Journal of Experimental Psychology*, *65*, 208-213.

Welsh, M. C., Satterlee-Cartmell, T., & Stine, M. (1999). Towers of Hanoi and London: Contribution of working memory and inhibition to performance. *Brain and cognition*, *41*, 231-242.

Xu, Z., Adam, K., Fang, X., & Vogel, E. (2017). The reliability and stability of visual working memory capacity. *Behavior Research Methods*, *50*, 576-588.

Zook, N. A., Davalos, D. B., DeLosh, E. L., & Davis, H. P. (2004). Working memory, inhibition, and fluid intelligence as predictors of performance on Tower of Hanoi and London tasks. *Brain and Cognition*, *56*, 286-292.