

Research Report

‘‘That Is Bloody Revolting!’’

Inhibitory Control of Thoughts Better Left Unsaid

William von Hippel and Karen Gonsalkorale

University of New South Wales, Sydney, Australia

ABSTRACT—*An experiment explored the hypothesis that inhibitory ability helps people stop themselves from engaging in socially inappropriate behavior. All participants completed a Stroop color-naming task, after which half of the participants were asked to remember an eight-digit number (inducing divided attention). Participants were then offered an unfamiliar and visually unappetizing food product (a chicken foot) under conditions of either low or high social pressure to pretend that it was appealing. Participants who had full attention available and were under pressure to pretend the food was appealing were least likely to emit a negative response, and performance on the Stroop task predicted the degree to which they successfully restrained negative responses. These results suggest that the cognitive ability to inhibit unwanted information facilitates socially appropriate behavior.*

With all the inappropriate and unfriendly things that people think and say about each other (Rosnow, 2001), how is it that interpersonal interaction is so often positive? What enables translation of socially insensitive or inappropriate cognition into pleasant interaction? One answer to this question focuses on the role of cognitive inhibition in social interaction. Specifically, it may be the case that effortful inhibition of inappropriate but prepotent responses is a critical cognitive component of social skill.

The clearest support for this idea can be found in research on individuals who have compromised inhibitory functioning, because they are very young (Kieras, Tobin, Graziano, & Rothbart, 2005), are very old (von Hippel & Dunlop, in press), or have brain damage (Beer, Heerey, Keltner, Scabini, & Knight, 2003). With regard to young children, those who perform better on measures of inhibition are also better able to mask their disappointment when they receive a gift they do not like (Kieras et al., 2005). At the other end of the life span, research suggests that age-

related increases in social inappropriateness are mediated by inhibitory losses (von Hippel & Dunlop, in press).

These findings suggest that social control is achieved in part through inhibition, but it is unclear whether inhibition plays a role in social functioning among individuals whose inhibitory faculties are intact. On the one hand, it may be the case that inhibition is largely irrelevant, and that knowledge of the rules of social interaction is all that is necessary to be socially skilled. For example, Salovey and Mayer's (1990) provocative theory of emotional intelligence tacitly equates understanding how to manage emotions with the ability to actually do so in complex social situations. Experimental results support such a possibility, as the emotion-management subscale of their emotional intelligence test (Mayer, Salovey, & Caruso, 2002) predicts people's ability to get along with their friends (Lopes et al., 2004). The roots to this approach can be found in Argyle's (1969) seminal research on social skills, which suggested that social skills emerge from knowledge of social rules rather than ability to apply them.

The success of these major research programs attests to the importance of knowledge of social rules, but there may nevertheless be important individual differences that determine who can apply these rules in challenging circumstances. Suggestive support for such a possibility can be found in research on self-regulation. For example, White participants who have high levels of implicit prejudice show self-regulatory fatigue after engaging in an interracial interaction, which suggests that they may be inhibiting stereotypic thoughts during the interaction (Richeson & Shelton, 2003; see also Richeson et al., 2003). Additionally, self-regulatory fatigue has been found to reduce accommodative responses to hypothetical negative behaviors by romantic partners (Finkel & Campbell, 2001); this result suggests that inhibitory processes may be involved in forgiving partners' transgressions.

The goal of the current research was to extend these findings and examine directly the role of inhibition in social behavior. Inhibition was assessed via the Stroop task. This task requires participants to name the ink color in which each of a series of color words is written. When most of the color words are inconsistent with the color of their ink, efficient naming of the ink colors requires inhibition of the meanings of the words (activated au-

Address correspondence to William von Hippel, School of Psychology, University of New South Wales, Sydney 2052, Australia; e-mail: w.vonhippel@unsw.edu.au.

tomatically by proficient readers). Therefore, the Stroop task provides a useful indicator of individual differences in inhibitory ability, and it is widely used for that purpose (e.g., Alain & West, 2000; Long & Prat, 2002).

An important problem with most measures of inhibition, however, is that they contain both activation and inhibition components. A person who shows substantial slowing in color naming when presented with incongruent color words might have poor ability to inhibit word meaning. Alternatively, such a person might have a strong tendency to activate word meaning, so that greater inhibition would be required for that person to perform at the same level as others who do not have such a strong tendency for activation. Thus, if the Stroop task is to be interpreted as a measure of inhibitory ability, it is necessary to use it in a context that rules out activation differences as a likely cause of effects that emerge.

In the current experiment, such a context was created by studying verbal and nonverbal blurring (cf. Swann & Rentfrow, 2001). Participants were asked to eat an unusual food item that was graphically similar to the animal part from which it had originated. Specifically, they were presented with a chicken foot cooked in a Chinese style that preserved the entire foot intact, including the claws. Social pressure not to blurt was manipulated by the way that the chicken foot was presented—by a Chinese experimenter who suggested prior to presentation that it was a culturally significant dish and a personal favorite or by a White experimenter who simply noted that it was Chinese food.

This manipulation of social pressure made it possible to test whether the inhibitory component, rather than the activation component, of the Stroop task predicts blurring. If the activation component predicts blurring, then Stroop performance should have predicted blurring equally whether the experimenter was White or Chinese, as these two conditions involved equivalent activation of the unappealing aspects of the chicken foot. In contrast, if the inhibition component predicts blurring, then Stroop performance should have predicted blurring only when the experimenter was Chinese, as only in this condition were participants motivated to suppress a negative response.

In addition to this manipulation of social pressure, the current experiment included a manipulation of divided attention. The goal of this manipulation was to provide sufficient distraction so that even good inhibitors would unintentionally blurt a negative response when confronted with the chicken foot. Again, however, divided attention was expected to affect blurring only when the experimenter was Chinese, as only with a Chinese experimenter would participants try to suppress a negative response. Thus, divided attention was expected to lead to increased blurring only with the Chinese experimenter, and Stroop performance was expected to predict blurring only with the Chinese experimenter when participants had full attention available to devote to social control.

Because nonverbal responses are more difficult to control than verbal responses (DePaulo, 1992), it seemed possible that nonverbal responses would be more sensitive to the experimental manipulations than verbal responses would be, and that inhibi-

tory ability would more clearly predict nonverbal than verbal behavior. Nevertheless, previous research has demonstrated clear individual differences in verbal blurring (Swann & Rentfrow, 2001), and thus both nonverbal and verbal behavior were expected to be sensitive to inhibitory ability and social pressure.

METHOD

Participants

Seventy-one non-Asian undergraduates at the University of New South Wales, Australia, participated in this experiment in partial fulfillment of course requirements. The experiment was described as a study of the impact of different food chemicals on memory.

Materials and Procedure

Participants were given a Stroop color-naming task in which they first named aloud the ink colors of 44 color blocks and then named the ink colors of 44 color words whose letters were printed in a color inconsistent with most of the word meanings (e.g., *red* printed in green ink). After completing the Stroop task, participants who were randomly assigned to the divided-attention condition were asked to remember an eight-digit number.

In the social-pressure condition, a Chinese experimenter then told participants that they were fortunate to be in Condition 1, as they would have the opportunity to taste what many people regard as the national dish of China, which was also her personal favorite. In contrast, participants randomly assigned to the no-pressure condition were told by a White experimenter that they were in Condition 1, which meant they would taste a Chinese dish. In both conditions, the experimenter then placed a container in close proximity to the participants' faces and opened it to clearly reveal a chicken foot. Participants' facial reactions and utterances were recorded by a hidden video camera.

At this point, some participants expressed a desire not to eat the chicken foot. These participants were reassured that their data would still be useful, and their choice was recorded. Participants who proceeded to eat the chicken foot were told that they should consume one or two toes. Participants in the divided-attention condition were then asked to recall the eight-digit number, so that they were cognitively busy during their encounter with the chicken foot, but not during any other stage of the experiment. Finally, participants completed the Ten Item Personality Inventory (TIPI; Gosling, Rentfrow, & Swann, 2003) and indicated how often in their lives they had seen chicken feet as food.

RESULTS

Two raters who were blind to condition coded verbal and nonverbal blurring as negative (+1), neutral (0; this code was also used if there was no reaction), or positive (−1). Initial interrater reliability was moderate ($r_s = .72$ and $.65$), and disagreements were resolved by discussion. Verbal and nonverbal reactions

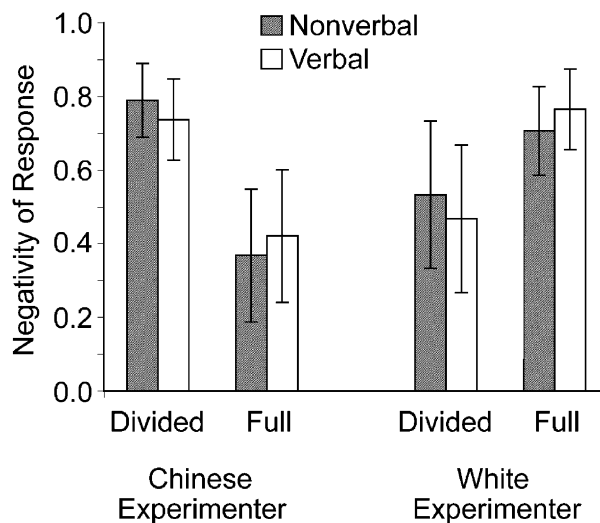


Fig. 1. Judges' ratings of the negativity of participants' nonverbal and verbal responses to the chicken foot as a function of ethnicity of the experimenter and attention (full vs. divided). Error bars show standard errors.

were then subjected to a mixed-model analysis of covariance, with verbal versus nonverbal reaction as a within-subjects factor and social pressure and divided attention as between-subjects factors. Participants' ratings of how often they had seen chicken feet as food and their scores on the subscale of the TIPI that taps openness to new experience were included as covariates; they were nonsignificant in this analysis, $F(1, 65) = 1.16, p > .25$.

As can be seen in Figure 1, this analysis revealed the predicted interaction between social pressure and divided attention, $F(1, 65) = 3.98, p = .05$, and no three-way interaction or main effects, $F_s < 1, n.s.$ Simple effects analyses revealed that the impact of divided attention on verbal and nonverbal behavior was marginally significant when the experimenter was Chinese, $F(1, 65) = 3.39, p = .07$, and nonsignificant when the experimenter was White, $F(1, 65) = 1.13, p > .25$. Separate analyses of verbal and nonverbal responses revealed that with nonverbal behavior, the effect of divided attention was significant when the experimenter was Chinese, $F(1, 65) = 4.57, p < .04$, but not when she was White, $F < 1, n.s.$ Although the pattern was the same with verbal responses, a significant effect failed to emerge for divided attention when the experimenter was Chinese, $F(1, 65) = 2.40, p > .10$, or White, $F < 1, n.s.$

Participants' choice of whether to eat the chicken foot was then analyzed in a logistic regression, in which the predictor variables in the first step were experience with chicken feet as food, openness to new experience, and social pressure and divided attention, and the predictor variable in the second step was the interaction between social pressure and divided attention. This analysis revealed the predicted effect for social pressure ($B = 1.22, Wald = 5.02, p < .03$), such that participants were more likely to eat the foot when the experimenter was Chinese (52.6%) than when she was White (27.3%). This analysis also revealed an effect for openness to new experience ($B = -0.57, Wald = 4.33,$

$p < .04$), but no interaction between social pressure and divided attention ($B = 0.24, Wald = 0.79, p > .35$).

The central hypothesis was that inhibitory ability would be differentially related to blurting as a function of social pressure and divided attention. As a first step to test this hypothesis, performance on the Stroop task was computed as the difference in reading time between the color words and the color blocks, divided by the time required to read the color blocks. This ratio score controls for overall differences in speed (although the findings were unchanged when Stroop performance was scored simply as a difference score between reading times for color words and color blocks). In each condition, partial correlations were computed between Stroop scores and nonverbal and verbal responses, with experience with chicken feet as food and openness to experience as control variables.

The differences between these partial correlations were then analyzed in a three-stage process. In the first stage, a saturated covariance structure model was estimated, with paths between Stroop performance, the nonverbal or verbal response, experience with chicken feet, and openness to new experience. Because the model was saturated, the fit was perfect. In the second stage, the partial correlation between Stroop performance and the nonverbal or verbal response was constrained to equivalence in all conditions but the one in which the experimenter was Chinese and participants had full attention available. The results for this model were consistent with the prediction that inhibitory ability played little or no role in any of these conditions; the added constraint did not lead to significantly poorer fit of the model with either nonverbal responses, $\chi^2(2, N = 68) = 1.68, n.s.$, or verbal responses, $\chi^2(2, N = 68) = 1.71, n.s.$ In the third stage, the partial correlation between Stroop performance and the nonverbal or verbal response was constrained to equivalence in all four conditions; this stage tested whether the partial correlation when the experimenter was Chinese and full attention was available differed significantly from the average partial correlation of the other three conditions. Results were consistent with predictions in that this added constraint yielded significantly poorer fit for both nonverbal responses, $\chi^2(1, N = 68) = 7.36, p < .01$, and verbal responses, $\chi^2(1, N = 68) = 3.94, p < .05$ (see Table 1).

DISCUSSION

When people were asked to eat a chicken foot by a Chinese experimenter, they were more likely to make a socially inappropriate response if their ability to inhibit was disrupted by divided attention than if they had full attention available. Similarly, people who were asked to eat a chicken foot by a Chinese experimenter and had full attention available were more likely to make a socially inappropriate response if they had poor rather than good inhibitory ability. These results provide converging evidence that cognitive inhibitory processes play an important role in the control of social behavior. In so doing, these results also provide evidence that social skills are not just a function of

TABLE 1
Partial Correlations Between Stroop Scores and Nonverbal and Verbal Responses

Response	Chinese experimenter		White experimenter	
	Divided attention	Full attention	Divided attention	Full attention
Nonverbal	-.34 (.22)	.54* (.17)	.12 (.27)	-.20 (.24)
Verbal	-.25 (.23)	.36 (.20)	.12 (.27)	-.34 (.22)

Note. Standard errors are presented in parentheses.
 * $p < .05$.

knowing the social rules, but are also dependent on the ability to apply these rules in challenging circumstances.

Perhaps the most striking aspect of these results is that a correlation emerged between two tasks that, at least on the surface, appear to involve control of such different kinds of responses. The fact that successful suppression of word meaning to enable rapid naming of ink colors predicted successful suppression of disgust toward a Chinese-style chicken foot to enable polite interaction with a Chinese experimenter suggests that there is overlap in the inhibition and control required by these two tasks. The literature on cognitive inhibition is plagued by the fact that different measures of inhibition are often uncorrelated (Kramer, Humphrey, Larish, Logan, & Strayer, 1994). There are a number of theories intended to explain these dissociations (e.g., Friedman & Miyake, 2004), but the current results suggest that it may be useful to examine the relationships between measures of cognitive inhibition and problems of social control. If the prefrontal cortex developed in part to enable voluntary control over sexual and aggressive behavior (Bjorklund & Harnishfeger, 1995) or other behaviors that may not serve long-term interests (Boysen, Mukobi, & Berntson, 1999; Kieras et al., 2005; Mischel & Ayduk, 2004), then proper understanding of different measures of cognitive inhibition may be facilitated by examining their role in social functioning.

Acknowledgments—This research was supported by Grant R01 17842 from the National Institute of Aging and a grant from the Australian Research Council. We thank Kris Preacher for assistance with data analysis.

REFERENCES

- Alain, C., & West, R. (2000). Age-related decline in inhibitory control contributes to the increased Stroop effect observed in older adults. *Psychophysiology*, *37*, 179–189.
- Argyle, M. (1969). *Social interaction*. Oxford, England: Atherton Press.
- Beer, J.S., Heerey, E.H., Keltner, D., Scabini, D., & Knight, R.T. (2003). The regulatory function of self-conscious emotion: Insights from patients with orbitofrontal damage. *Journal of Personality and Social Psychology*, *85*, 594–604.

- Bjorklund, D.F., & Harnishfeger, K.K. (1995). The evolution of inhibition mechanisms and their role in human cognition and behavior. In F.N. Dempster & C.J. Brainerd (Eds.), *Interference and inhibition in cognition* (pp. 141–176). San Diego, CA: Academic Press.
- Boysen, S.T., Mukobi, K.L., & Berntson, G.G. (1999). Overcoming response bias using symbolic representations of number by chimpanzees (*Pan troglodytes*). *Animal Learning & Behavior*, *27*, 229–235.
- DePaulo, B.M. (1992). Nonverbal behavior and self-presentation. *Psychological Bulletin*, *111*, 203–243.
- Finkel, E.J., & Campbell, W.K. (2001). Self-control and accommodation in close relationships: An interdependence analysis. *Journal of Personality and Social Psychology*, *81*, 263–277.
- Friedman, N.P., & Miyake, A. (2004). The relations among inhibition and interference control functions: A latent-variable analysis. *Journal of Experimental Psychology: General*, *133*, 101–135.
- Gosling, S.D., Rentfrow, P.J., & Swann, W.B. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in Personality*, *37*, 504–528.
- Kieras, J.E., Tobin, R.M., Graziano, W.G., & Rothbart, M.K. (2005). You can't always get what you want: Effortful control and children's responses to undesirable gifts. *Psychological Science*, *16*, 391–396.
- Kramer, A.F., Humphrey, D.G., Larish, J.F., Logan, G.D., & Strayer, D.L. (1994). Aging and inhibition: Beyond a unitary view of inhibitory processing in attention. *Psychology and Aging*, *9*, 491–512.
- Long, D.L., & Prat, C.S. (2002). Working memory and Stroop interference: An individual differences investigation. *Memory & Cognition*, *30*, 294–301.
- Lopes, P.N., Brackett, M.A., Nezlek, J., Schütz, A., Sellin, I., & Salovey, P. (2004). Emotional intelligence and social interaction. *Personality and Social Psychology Bulletin*, *30*, 1018–1034.
- Mayer, J.D., Salovey, P., & Caruso, D.R. (2002). *Mayer–Salovey–Caruso Emotional Intelligence Test (MSCEIT) item booklet*. Toronto, Ontario, Canada: MHS Publishers.
- Mischel, W., & Ayduk, O. (2004). Willpower in a cognitive-affective processing system: The dynamics of delay of gratification. In R.F. Baumeister & K.D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 99–129). New York: Guilford Press.
- Richeson, J.A., Baird, A.A., Gordon, H.L., Heatherton, T.F., Wyland, C.L., Trawalter, S., & Shelton, J.N. (2003). An fMRI examination of the impact of interracial contact on executive function. *Nature Neuroscience*, *6*, 1323–1328.
- Richeson, J.A., & Shelton, J.N. (2003). When prejudice does not pay: Effects of interracial contact on executive function. *Psychological Science*, *14*, 287–290.
- Rosnow, R.L. (2001). Rumor and gossip in interpersonal interaction and beyond: A social exchange perspective. In R.M. Kowalski (Ed.), *Behaving badly: Aversive behaviors in interpersonal relationships* (pp. 203–232). Washington, DC: American Psychological Association.
- Salovey, P., & Mayer, J.D. (1990). Emotional intelligence. *Imagination, Cognition, and Personality*, *9*, 185–211.
- Swann, W.B., Jr., & Rentfrow, P.J. (2001). Blirtatiousness: Cognitive, behavioral, and physiological consequences of rapid responding. *Journal of Personality and Social Psychology*, *81*, 1160–1175.
- von Hippel, W., & Dunlop, S.M. (in press). Aging, inhibition, and social inappropriateness. *Psychology and Aging*.

(RECEIVED 10/21/03; REVISION ACCEPTED 9/30/04)