

Verbalization Produces a Transfer Inappropriate Processing Shift

JONATHAN W. SCHOOLER*

University of Pittsburgh, USA

SUMMARY

When considered in the context of prior research, the articles in this special issue on verbal overshadowing largely support the contention that verbalization can induce a processing shift that interferes with the application of non-verbal operations. Multiple sources of evidence for a processing shift are reviewed, including: (1) verbalization quality often does not correspond to recognition performance; (2) describing one stimulus can interfere with memory for a different stimulus; (3) engaging in a featural processing tasks impairs recognition in a manner comparable to verbalization; and (4) engaging in non-verbal tasks can reverse the negative effects of verbalization. In the light of this evidence, it is suggested that verbalization produces a 'transfer inappropriate processing shift' whereby the cognitive operations engaged in during verbalization dampen the activation of brain regions associated with critical non-verbal operations. This account of verbal overshadowing is then used to explain both the generality and fragility of the verbal overshadowing effect. Copyright © 2002 John Wiley & Sons, Ltd.

A hallmark of human achievement is the ability to translate experiences into words. Although clearly fundamental, there are nevertheless some situations under which the act of verbal translation can be inopportune. Specifically, when people attempt to verbalize non-verbalizable memories (such as the appearance of a face or a colour) memory impairment for the described stimuli can ensue (Schooler and Engstler-Schooler, 1990). Originally, the disruptive effect of describing non-verbal memories (termed verbal overshadowing) was assumed to stem from the formation of a verbally recoded memory representation that interfered with access to the original memory. Although potentially applicable in some cases (e.g. Pellizon *et al.*, this issue; Meissner *et al.*, 2001; Meissner, this issue), a variety of verbal overshadowing findings (including several reported in this issue) simply cannot be accommodated by a recoding interference account. Rather, these studies suggest that verbalization produces a general processing shift that dampens individuals' ability to apply certain non-verbal operations. In the following discussion, I briefly summarize the various sources of evidence suggesting that verbalization produces a generalized processing shift. I then offer an expanded account of this mechanism, and close by considering how this account may help to explain both the generality and fragility of the verbal overshadowing effect.

*Correspondence to: Jonathan W. Schooler, Learning Research and Development Center, University of Pittsburgh, LRDC Building, 3939 O'Hara Street, Pittsburgh, PA 15260, USA. E-mail: Schooler+@pitt.edu

Contract/grant sponsor: Fetzer Institute.

EVIDENCE FOR A PROCESSING SHIFT

One of the central predictions of a recoding interference account of verbal overshadowing is that there should be a relationship between the quality of the verbal descriptions and recognition performance. Indeed, the presence of such a relationship has been a primary source of evidence used in support of this account (e.g. Meissner *et al.*, 2001). Although such a relationship has been observed in some studies (e.g. Finger and Pezdek, 1999; Meissner *et al.*, 2001; Meissner, this issue), many studies (Brown and Lloyd-Jones, in press, this issue; Kitagami *et al.*, this issue; Fallshore and Schooler, 1995; Schooler and Engstler-Schooler, 1990) have failed to find one. Although it seems quite plausible that inaccurate verbal descriptions may contribute to verbal overshadowing when a relationship between verbal descriptions and performance is observed, it is difficult to ascribe verbal overshadowing effects to the poor quality of verbal descriptions when no relationship between description quality and recognition performance is observed.

A second finding that is particularly problematic for a recoding interference account is the observation that verbal overshadowing often extends beyond the particular stimulus that is verbalized. For example, Dodson *et al.* (1997) had participants describe only one of two previously seen faces. They observed that verbalization not only impaired recognition of the verbalized face, but it also impaired recognition of the non-verbalized face. In a related paradigm, Brown and Lloyd-Jones (in press, this issue) find that verbally describing the last of twelve previously presented faces impairs participants' recognition of both the described face and the remaining eleven non-described faces. Brown and Lloyd-Jones (in press) further find that describing a single face can even interfere with participants' ability to recognize an entirely different type of non-verbal stimulus: a previously seen car (although see Westerman and Larsen, 1997). If the effects of verbalization are the result of relying on impoverished verbal representation, then it is extremely hard to explain why participants would continue to apply that representation when attempting to recognize stimuli other than that which was verbalized.

An additional source of evidence against recoding interference as a full account of verbal overshadowing comes from studies examining the impact of manipulations besides verbalization. Macrae and Lewis (in press) recently demonstrated an effect that very closely resembled verbal overshadowing with a manipulation that did not require verbalization at all. In this study, participants viewed the videotape used in the original verbal overshadowing studies, and then viewed large letters composed of many small letters, attending either to the large or the small elements. On a subsequent recognition test, participants who focused at the featural level (i.e. on the small letters) performed much like participants in the original verbal overshadowing studies; i.e. worse than controls. In contrast, participants who focused at the gestalt level (i.e. on the large letters) actually performed better than controls. Macrae suggested that focusing on the individual letters induces a featural processing shift comparable to that previously hypothesized to be produced by verbal overshadowing.

Of course, the fact that focusing on the featural aspects of letters produces a processing shift that resembles the effect of verbal overshadowing does not in itself demonstrate that verbal overshadowing is due to such a shift. For example, we do not know whether focusing on the gestalt letters would necessarily reverse the negative effects of verbalization on face recognition, as would be expected if both paradigms elicit their effects by altering people's relative reliance on verbal or featural processing. However, findings reported by Finger (this issue) directly speak to this issue. Finger replicated the basic

verbal overshadowing paradigm, but in some conditions introduced a non-verbal task (listening to music or completing a maze) prior to the final test. She observed that engaging in these non-verbal tasks entirely eradicated the verbal overshadowing effect. Such findings are precisely what one would expect if verbalization produces a verbal processing shift that can be reversed by re-emphasizing non-verbal processing.

In sum, four general findings challenge the notion that verbal overshadowing is due to recoding interference resulting from a reliance on impoverished verbal description: (1) verbalization quality often does not correspond to recognition performance; (2) describing one stimulus can interfere with memory for a different stimulus; (3) engaging in a featural processing task produces a processing shift very much like that hypothesized to be produced by verbalization; and (4) engaging in non-verbal tasks can reverse the negative effects of verbalization. This is not to say that recoding interference may not apply in some cases. For example, the paradigm described by Pellizon *et al.* (this issue) in which visual memory performance is superior for hard-to-name forms relative to easy-to-name forms, seems reasonably explained by the notion that easy-to-name stimuli are more likely to be verbally recoded. Moreover, it is quite plausible that verbal recoding may contribute to verbal overshadowing effects in cases where a relationship between verbal description and memory performance is observed (e.g. Meissner, this issue). However, given the above considerations, it is clear that in many cases verbal overshadowing is not specifically dependent on the precise contents of the verbal description, thus strongly implicating a more general processing shift. Questions remain though about what causes this processing shift and what are the processes that are altered. I consider these questions in turn.

THE NATURE OF THE PROCESSING SHIFT

Schooler *et al.* (1997) suggested that the processing shift associated with verbal overshadowing results from what we termed 'transfer inappropriate retrieval'. Borrowing from transfer appropriate processing theory (e.g. Roediger *et al.*, 1989), we hypothesized that recognition performance should be impaired if participants fail to apply the same non-verbal processing operations at retrieval that were used at encoding. Drawing on research on retrieval inhibition (e.g. Anderson and Spellman, 1995), we further suggested that such difficulties could result from inhibition invoked by retrieval processes associated with the act of verbally describing a memory. Accordingly, we speculated that engaging in retrieval processes that emphasized one class of operations (i.e. verbal or featural) but not another (i.e. non-verbal or configural) may inhibit the de-emphasized operations on subsequent retrieval attempts. Research conducted since the articulation of the transfer inappropriate retrieval account provides strong support for the transfer inappropriate processing element of this view. For example, the finding that the negative effects of verbalization can be reversed by emphasizing non-verbal processes (Finger, this issue) strongly suggests that verbal overshadowing effects occur when there is a mismatch between encoding and retrieval processes. At the same time, it must be noted that the role of retrieval inhibition has become less clear. Specifically, it now appears that effects that closely resemble verbal overshadowing can be induced by engaging in cognitive operations that do not require retrieval (e.g. Macrae *et al.*, 2002). Although more research is necessary to tie this result to the standard verbal overshadowing paradigm, it certainly suggests that retrieval operations *per se* are not necessary in order to produce a processing shift that closely resembles that associated with verbal overshadowing. Furthermore, if retrieval inhibition were the reason

why inappropriate verbal processes are carried over from the act of verbalization to the final test, it is far from obvious why engaging in an entirely unrelated non-verbal process (e.g. listening to music) would necessarily release this inhibition.

Given the now somewhat dubious role that retrieval inhibition plays in producing the disruptive effects of verbal overshadowing, it seems reasonable to leave out retrieval from the accounts of verbal overshadowing and instead refer to the processing shift as a *transfer inappropriate processing shift*. Accordingly, verbal overshadowing effects are assumed to occur because verbalization induces inappropriate processing operations which, when carried over at the time of test, are incommensurate with the processes required for successful recognition performance. If we abandon (at least temporarily) the assumption that retrieval inhibition is the reason why processes engaged in at the time of verbal retrieval are carried over to the time of final recognition, the question remains as to what causes this carryover effect. Although this is clearly a topic for further investigation, evidence from the cognitive neuroscience literature suggests that dampening of non-activated cognitive processes may be a natural outcome of competition between brain regions. I briefly consider two examples of competition between processes associated with distinct brain regions that may be the source of the transfer inappropriate processing shift that is induced by verbal overshadowing: right versus left hemisphere processes, and automatic versus controlled processes.

Whereas language operations are closely linked with processes associated with the left hemisphere (Hellige, 1993), the right hemisphere has been shown to emphasize precisely the types of non-verbal configural processes that appear to be disrupted by verbalization (Leehey *et al.*, 1978). It is therefore notable that research on competition between brain hemispheres suggests that activation of one hemisphere can draw activation away from the other (e.g. Kinsbourne, 1970, 1975; Kosslyn, 1987). As Kosslyn (1987) observes '... a single, limited pool of activation is drawn upon by both hemispheres, and if one draws a proportionately large amount of activation, less is available for the other' (p. 160). Given the differential use of reportable versus non-reportable processes by the left and right hemispheres, it seems quite plausible that verbalization could change the relative activation of the two hemispheres, thereby altering participants' subsequent reliance on right versus left hemisphere processes.

Alternatively, or potentially in addition, verbalization may influence individuals' relative reliance on automatic versus controlled processing. It has long been recognized that many cognitive operations can be accomplished either more reflectively with controlled processes or more reflexively using automatic processes (Schneider and Shiffrin, 1997). More recently, evidence from cognitive neuroscience suggests that these automatic versus controlled operations (or what Lieberman *et al.*, in press, characterize as 'reflexive' versus 'reflective' processes) may draw on fundamentally different brain regions. Reflexive processes have been associated with activation of the amygdala, basal ganglia, and lateral temporal cortex, whereas reflective processes have been associated with activation of the anterior cingulate cortex, prefrontal cortex, and the medial temporal lobe, see Lieberman *et al.* for a review). Recent research also indicates that, like the two brain hemispheres, the controlled/reflective and automatic/reflexive processing systems can compete with one another, such that activation of one system can draw activation away from the other (Harri *et al.*, 2000; Lieberman, in press). It seems quite reasonable that verbalization could induce a greater reliance on controlled/reflective processes (Dunning and Stern, 1994; Fallshore and Schooler, 1995; Lieberman, in press; Schooler *et al.*, 1997; Schooler, 2002; Wilson and Schooler, 1991) and indeed this claim is supported both by the

findings that face recognition following verbalization takes longer (Brown and Lloyd-Jones, in press) and that the disruptive effects of verbalization are attenuated when participants are forced to make quick recognition decisions (Schooler and Engstler-Schooler, 1990; Wilson *et al.*, 2000). It therefore seems quite plausible that verbalization may produce a processing shift such that individuals put a greater reliance on brain regions associated with controlled reflective processing, deactivating the non-verbal automatic processes necessary for successful performance.

Although transfer inappropriate processing shifts may ultimately be found to correspond to one of the above set of competing brain regions, the above discussion is offered primarily as examples of the manner which dampening of brain activation *might* underlie verbal overshadowing. It is important to emphasize that the present account is a variant of standard resource competition models. In many models, resource competition is greatest when multiple tasks draw on the same underlying resources; e.g. when multiple tasks draw on the phonological loop (Baddeley, 1986; Baddeley and Logie, 1999). In contrast, here I speculate that drawing on one system may actually reduce the likelihood that individuals will draw on a different system. Although less commonly considered, the above examples illustrate that the activation of one brain system can dampen that of another, and thus provide a viable (if speculative) account of the type of mechanism that may produce the transfer inappropriate processing shift hypothesized to underlie verbal overshadowing.

THE GENERALITY OF VERBAL OVERSHADOWING

The suggestion that verbal overshadowing results from the dampening of non-verbal processes that are deactivated during the process of verbalization also readily accounts for the broad range of domains in which verbal overshadowing has been observed. Accordingly, verbal overshadowing should (in principle) be observed in any situation in which verbalization excludes processes that are critical for effective performance. In general, this means that verbal overshadowing should be a risk any time individuals attempt to verbalize cognitions that involve inherently non-verbal performance, and indeed the evidence on generality of verbal overshadowing tends to bear this out. In the past, verbal overshadowing has been associated with a variety of forms of non-verbal memory including faces (Schooler and Engstler-Schooler, 1990), colours (Schooler and Engstler-Schooler, 1990), shapes (Brandimonte *et al.*, 1997), taste (Melcher and Schooler, 1996) and music (Houser *et al.*, 'Verbal overshadowing of music memory: What happens when you describe that tune', unpublished manuscript, 2002). Similar disruptive effects of verbalization have also been observed across a variety of other domains known to rely on non-verbal cognition including insight problem solving (Schooler *et al.*, 1993), affective judgements (Wilson and Schooler, 1991), visual problem solving (DeShon *et al.*, 1995) and analogical reasoning (Sieck *et al.*, 1999). In contrast to the disruptive effects that verbalization has on non-verbalizable cognitions, tasks that rely on more verbalizable processes have proven to be relatively immune to the impact of verbalization. For example, whereas verbalizing the appearance of a robber's face impairs memory for the face, verbalizing what the robber said does not impair memory for the statement (Schooler and Engstler-Schooler, 1990). While verbalization impairs the non-verbal processes associated with insight problem solving, it has virtually no effect on the verbal/analytic processes associated with solving logic problems (Schooler *et al.*, 1993).

The research described in this volume largely complements prior studies with respect to both the domains in which verbal overshadowing is and is not found to generalize. As with memory for faces, describing one's memory for a voice is an extremely difficult task. It is therefore not surprising that Perfect *et al.* (this issue) observed that describing the quality of a voice impaired voice-recognition performance. Memory for the straight-line distances of a map is also highly reliant on configural mental representations, which are difficult to articulate (Hirtle and Hudson, 1991). Thus the finding that verbalization disrupts individuals' ability to recall the straight line distances between locations in a previously studied map is highly consistent with prior findings regarding the types of domains that should be vulnerable to verbalization (Fiore and Schooler, this issue).

The claim that verbalization particularly disrupts performance on tasks that rely on non-verbalizable processes is also largely consistent with the various situations in the present issue in which verbal overshadowing effects did not generalize. For example, in contrast to configural straight-line judgements, describing the route on a map is actually quite straightforward (e.g. take a left at the house). Thus, as expected memory for routes was not impaired by verbalization. It is also notable that Kitagami *et al.* (this issue) observed verbal overshadowing with the test arrays that included featurally similar distractors (thus requiring a reliance on difficult-to-verbalize configural processes), but not when the distractors were featurally dissimilar (enabling a reliance on more verbalizable featural processing).

Finally, the claim that verbalization is problematic to the degree that it causes individuals to verbally de-emphasize critical non-verbal processes can also help to account for various findings in the current volume that address the types of verbal descriptions that are particularly likely to lead to interference. For example, several studies found that verbal overshadowing effects were greatest when individuals were encouraged to verbalize individual facial features (Brown and Lloyd-Jones, this issue; Maclin, this issue). Such featural analysis may result in the de-emphasis of critical configural processes that are necessary for successful face recognition (Diamond and Carey, 1986; Fallshore and Schooler, 1995). Consistent with this view, R. MacLin reports that when participants are asked to describe the personality of a face (a manipulation that should not de-emphasize configural processing), no effects of verbal overshadowing were observed.¹

THE FRAGILITY OF THE VERBAL OVERSHADOWING EFFECT

The suggestion that verbal overshadowing results from a dampening of processes that are omitted during verbalization may also help to account for the disconcerting number of times that verbal overshadowing has failed to be observed (for a review see Meissner and Brigham, 2001). Accordingly, if verbal overshadowing is due to a processing shift stemming from an excessive emphasis on inappropriate processing, then it stands to reason that the more extensive the emphasis on the inappropriate processing, the more likely a processing shift is apt to occur. Although interpreted in a somewhat different manner, recent studies by Meissner *et al.* (2001) support this contention. Specifically, Meissner *et al.* found robust verbal overshadowing effects when participants were forced

¹It should be noted that R. MacLin (this issue) did observe significant effects of verbalization when participants described how a target face might resemble famous faces. Although this finding might seem to challenge the importance of an emphasis on individual features, it is important to note that MacLin specifically encouraged participants to think about how individuals might resemble a combination of different famous faces. By considering how different parts of the face might resemble different people, participant very likely engaged in precisely the type of verbal decomposition that is hypothesized to cause verbal overshadowing.

to engage in extensive verbalization elicited by requiring participants to fully complete a blank lined page with a description of the previously seen face. In contrast, when participants were not required to engage in such exhaustive verbalizations, no verbal overshadowing was observed. In a subsequent meta-analysis, Meissner and Brigham (2001) found that whether or not experimenters encouraged participants to spend their entire assigned time describing the face was a critical variable in determining the reliability of the verbal overshadowing effect.² Although Meissner *et al.* interpreted these findings as evidence that verbalization is due to a self-generated misinformation effect (i.e. recoding interference), an equally tenable account is that the more emphasis participants put in verbal processing, the more likely they are to dampen non-verbal processes, and subsequently to experience a transfer inappropriate processing shift.

CONCLUSION

In sum, I have argued that the findings presented in this issue are largely consistent with prior research in suggesting that verbalization produces a generalized processing shift that dampens individuals reliance on non-verbal processes. When subsequently confronted with a task that requires such processes, individuals experience transfer inappropriate processing whereby they are unable to apply the optimum processes for completing the task. Because this account assumes a generalized processing shift, it is consistent with various findings demonstrating that the effects of verbalization are often not dependent on the precise contents of what is verbalized. Because it assumes that verbalization can in principle dampen any non-verbal process, it is consistent with the surprising breadth of domains in which verbal overshadowing has been observed. Finally, because it assumes that extensive verbal processing may be required to induce this shift, it helps to explain why researchers sometimes fail to successfully observe verbal overshadowing.

In this commentary I also speculated that the transfer inappropriate processing shift associated with verbal overshadowing might reflect competition between brain regions. Fortunately, recent developments in verbal overshadowing research make exploration of this hypothesis increasingly feasible. Specifically, for many years it was not possible to explore whether verbal overshadowing results from competition between brain regions. This is due to the fact that verbal overshadowing effects are typically only observed on a single trial whereas measurements of brain activation require numerous observations. However, with Brown and Lloyd Jones (this issue) recent development of a verbal overshadowing paradigm that produces effects across multiple trials, the field is ripe for examining whether the transfer inappropriate processing shifts hypothesized to be induced by verbalization correspond to increased activation of some brain regions and dampening of others.

ACKNOWLEDGEMENTS

The writing of this manuscript was supported by a grant from the Fetzer Institute through the Center for Consciousness Studies at the University of Arizona. The author wishes to thank Sonya Dougal and Jeff Gruen for helpful comments.

²The importance of extensive verbalization may also help to explain the failures to observe verbal overshadowing in the present volume. O. MacLin *et al.* (this issue) failed to show significant verbal overshadowing for participants who completed their 31-item verbal feature checklist. It seems plausible that a checklist produces less extensive verbal analysis than does a fully written verbal description. Moreover, when performance in the verbal checklist conditions is compared to that of controls, a modest albeit non-significant 10% difference in performance was observed.

REFERENCES

- Anderson MC, Spellman BA. 1995. On the status of inhibitory mechanisms in cognition: memory retrieval as a model case. *Psychological Review* **102**: 68–100.
- Baddeley AD. 1986. *Working Memory*. Clarendon Press/Oxford University Press: New York.
- Baddeley AD, Logie RH. 1999. Working memory: the multiple-component model. In *Models of Working Memory: Mechanisms of Active Maintenance and Executive Control*, Miyake AS, Priti (eds). Cambridge University Press: New York; 28–61.
- Brandimonte MA, Schooler JW, Gabbino P. 1997. Attenuating verbal overshadowing through visual retrieval cues. *Journal of Experimental Psychology: Learning Memory and Cognition* **23**: 915–931.
- Brown C, Lloyd-Jones TJ. in press. Verbal overshadowing of multiple face and car recognition: effects of within versus across-category verbal descriptions. *Applied Cognitive Psychology*.
- DeShon RP, Chan D, Weissbein DA. 1995. Verbal overshadowing effects on Raven's Advanced Progressive Matrices: evidence for multidimensional performance determinants. *Intelligence* **21**: 135–155.
- Diamond R, Carey S. 1986. Why faces are and are not special: an effect of expertise. *Journal of Experimental Psychology: General* **115**: 107–117.
- Dodson CS, Johnson MK, Schooler JW. 1997. The verbal overshadowing effect: why descriptions impair face recognition. *Memory and Cognition* **25**: 129–139.
- Dunning D, Stern LB. 1994. Distinguishing accurate from inaccurate eyewitness identifications via inquiries about decision processes. *Journal of Personality and Social Psychology* **65**: 818–835.
- Fallshore M, Schooler JW. 1995. The verbal vulnerability of perceptual expertise. *Journal of Experimental Psychology: Learning, Memory and Cognition* **21**: 1608–1623.
- Finger K, Pezdek K. 1999. The effect of verbal description on face identification accuracy: release from verbal overshadowing. *Journal of Applied Psychology* **84**: 340–348.
- Hariri AR, Bookheimer SY, Mazziotta JC. 2000. Modulating emotional responses: effects of a neocortical network on the limbic system. *Neuroreport* **11**: 43–48.
- Hellige JB. 1993. *Hemispheric Asymmetry: What's Right and What's Left*. Harvard University Press: Cambridge, MA.
- Hirtle SC, Hudson J. 1991. Acquisition of spatial knowledge for routes. *Journal of Environmental Psychology* **11**: 335–345.
- Kinsbourne M. 1970. The cerebral basis of lateral asymmetries in attention. *Acta Psychologica* **33**: 193–201.
- Kinsbourne M. 1975. The mechanism of hemispheric control of the lateral gradient of attention. In *Attention and Performance V*, Rabbitt PMA, Dornic S (eds). Academic Press: New York; 81–97.
- Kinsbourne M. 1982. Hemispheric specialization and the growth of human understanding. *American Psychologist* **37**: 411–420.
- Kosslyn SM. 1987. Seeing and imagining in the cerebral hemispheres: a computational approach. *Psychological Review* **94**: 148–175.
- Leehey SC, Carey S, Diamond R, Cahn A. 1978. Upright and inverted faces: the right hemisphere knows the difference. *Cortex* **14**: 411–419.
- Lieberman MD. in press. Reflective and reflexive judgment processes: a social cognitive neuroscience approach. In *Social Judgments: Explicit and Implicit Processes*, Forgas JP, Williams KR, von Hippel W (eds). Cambridge University Press: New York.
- Lieberman MD, Gaunt R, Gilbert DT, Trope Y. in press. Reflection and reflexion: a social cognitive neuroscience approach to attributional inference. In *Advances in Experimental Social Psychology* (Vol. 34), Zanna M (ed.). Academic Press: New York.
- Macrae CN, Lewis HL. 2002. Do I know you? Processing orientation and face recognition. *Psychological Science* **13**: 194–196.
- Meissner CA, Brigham JC. 2001. A meta-analysis of the verbal overshadowing effect in face identification. *Applied Cognitive Psychology* **15**: 603–616.
- Meissner CA, Brigham JC, Kelley CM. 2001. The influence of retrieval processes in verbal overshadowing. *Memory and Cognition* **29**(1): 176–186.
- Melcher J, Schooler JW. 1996. The misremembrance of wines past: verbal and perceptual expertise differentially mediate verbal overshadowing of taste. *The Journal of Memory and Language* **35**: 231–245.

- Roediger HL, Weldon MS, Challis BH. 1989. Explaining dissociations between implicit and explicit measures of retention: A processing account. In *Varieties of Memory and Consciousness: Essays in Honour of Endel Tulving*, Roediger HL, Craik FIM (eds). Lawrence Erlbaum Associates: Hillsdale, NJ; 3–41.
- Schneider W, Shiffrin RM. 1977. Controlled and automatic human information processing: I. Detection, search, and attention. *Psychological Review* **84**: 1–66.
- Schooler JW, Engstler-Schooler TY. 1990. Verbal overshadowing of visual memories: some things are better left unsaid. *Cognitive Psychology* **17**: 36–71.
- Schooler JW, Ohlsson S, Brooks K. 1993. Thoughts beyond words: when language overshadows insight. *Journal of Experimental Psychology: General* **122**: 166–183.
- Schooler JW. 2002. Re-representing consciousness: dissociations between consciousness and meta-consciousness. *Trends in Cognitive Science* **6**: 339–344.
- Schooler JW, Fiore SM, Brandimonte MA. 1997. At a loss from words: verbal overshadowing of perceptual memories. In *The Psychology of Learning and Motivation*, Medin DL (ed.). Academic Press: San Diego, CA; 293–334.
- Schooler JW, Ryan RS, Reder L. 1996. The costs and benefits of verbally rehearsing memory for faces. In *Basic and Applied Memory: New Findings*, Herrmann D, Johnson M, McEvoy C, Hertzog C, Hertel P (eds). Erlbaum: Hillsdale, NJ; 51–65.
- Sieck WR, Quinn CN, Schooler JW. 1999. Justification effects on the judgment of analogy. *Memory and Cognition* **27**: 844–855.
- Westerman DL, Larsen JD. 1997. Verbal-overshadowing effect: evidence for a general shift in processing. *American Journal of Psychology* **110**: 417–428.
- Wilson TD, Schooler JW. 1991. Thinking too much: introspection can reduce the quality of preferences and decisions? *Journal of Personality and Social Psychology* **60**: 181–192.
- Wilson TD, Lindsey S, Schooler TY. 2000. A model of dual attitudes. *Psychological Review* **107**: 101–126.