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Group Differences in Suppression Skill*

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Abstract

It is proposed that there are group differences in suppression skill, and one such grouping is the distinction between more versus less skilled university-aged comprehenders. Experiments supporting this proposal and demonstrating that university-aged adults differ in their ability to suppress irrelevant, inappropriate, potentially interfering information are reviewed. Many of these experiments have been replicated with other groups, which also hypothetically differ in their ability to suppress inappropriate information. Two new sets of experiments are reviewed. In one, the prediction that less skilled comprehenders- because they are less skilled at suppression- should be better at comprehending puns is evaluated. In the other, the prediction that less skilled comprehenders- because they are less skilled at suppression- are better able to shift to a different meaning of a homonym is evaluated. Both sets of data are evaluated with respect to a general slowing explanation and scaling artifacts.

Neonates are not the only ones who experience a blooming, buzzing, bustle of confusion. In many situations, irrelevant or inappropriate information is activated, unconsciously retrieved, or naturally perceived. If we are to comprehend successfully what is going on about us in the world, inappropriate or irrelevant information must not be allowed to affect our ongoing cognitive processes; it must be quickly suppressed.

Suppression is the dampening or attenuating of activation. Suppression contrasts with inhibition, which is the blocking of activation. Consider the analogy of a candle. If igniting the candle's flame is analogous to activation, then any action that impedes or obstructs that ignition -for instance, wetting the wick or reducing the environmental oxygen- is analogous to inhibition. In contrast, snuffing out the already ignited flame is analogous to suppression. As this analogy suggests, a crucial difference between suppression and inhibition is whether the metaphorical candle is lit. Suppression requires a flame to dampen (i.e., it requires that the mental information is already activated in order for it to be suppressed). Suppression can lead to inhibition, as in the case of *negative priming* (e.g., Tipper, 1985; for a review see May, Kane, & Hasher, 1995), where ignoring a distractor on one trial (suppression) makes that stimulus harder to activate on a subsequent trial (inhibition); however, suppression and inhibition are distinct phenomena.

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Suppression and inhibition should also be distinguished from interference. Interference also arises from activated mental representations; it requires activated mental representations that, by definition, are interfering. To return to the candle analogy, interference is the already ignited flame that in a perfect world would be extinguished because it is inappropriate, irrelevant, or otherwise disruptive. Therefore, by definition, interference cannot be inhibited but it can be suppressed.

Lastly, where does Dempster's (1993) *resistance to interference* fit in? If (the representation of) the interfering stimulus has been activated, then resistance to interference falls under suppression (a dampening of activation because the activated information is irrelevant, inappropriate, or otherwise interfering). If (the representation of) the interfering stimulus has not been activated yet, then the resistance to that interference is similar to inhibition (a preactivation blocking so that the information is not allowed to be activated). These definitions should be kept in mind as the following empirical findings are described.

THE ORIGINAL FINDING

A few years ago we discovered that university-aged adults differ in their ability to suppress irrelevant, inappropriate, potentially interfering information. In these experiments we tested more versus less skilled university-aged participants after measuring their comprehension skills on a multimedia comprehension battery (Gernsbacher & Varner, 1988). This battery measures participants' ability to comprehend written stories, spoken stories, and picture stories, although comprehension of the three media is very highly correlated. In each experiment we tested a sample of participants on the comprehension battery, and then selected the more skilled comprehenders from the top third of the distribution and the less skilled comprehenders from the bottom third.

In the first experiment (Gemsbacher, Varner, & Faust, 1990, Experiment 4) we discovered that less skilled comprehenders were less able to quickly suppress the inappropriate meanings of homonyms (e.g., SPADE). In this experiment, we presented more versus less skilled comprehenders with a series of sentences, for example, "He dug with the spade." and after participants read each sentence, we presented a test word, for example, ACE. The participants' task was to decide whether the test word fit the meaning of the sentence that they had just read. We measured how long participants needed to decide that a test word like ACE did not fit the meaning of the sentence that they had just read, and we compared that to how long participants took to decide that the same word did not fit the meaning of a comparison sentence, such as "He dug with the shovel."

When we presented the test words immediately after participants read the sentences, we observed that both the more and less skilled comprehenders took longer to reject a test word that was related to the inappropriate meaning of the sentence-final homonym than they did to reject the same test word when it followed an unrelated sentence. This result suggests that activation from the inappropriate meanings was causing interference for both the more and less skilled comprehenders, at this immediate test interval. However, when we presented the test words 850 ms after participants read the sentences, the more skilled comprehenders no longer showed any interference, and this suggests that the more skilled comprehenders had

successfully suppressed the inappropriate meanings of the homonyms. The less skilled comprehenders, however, were still experiencing interference even after the 850 ms delay. We concluded that less skilled comprehendcrs are less able to quickly suppress the inappropriate meanings of homonyms.

REPLICATIONS AND EXTENSIONS

In another experiment (Gernsbacher & Faust, 1991, Experiment I) less skilled comprehenders were less able to quickly suppress the inappropriate forms of homophones. In this experiment the critical sentences contained a homophone, for example, “He had lots of patience,” and the test word was related to the other form of the homophone, for example, CALM. Again we found that immediately after participants read the sentences, both the more and less skilled comprehenders took longer to reject a test word like CALM following a sentence like “He had lots of patience” than they did to reject the same test word following a sentence that did not contain a homophone, for example, “He had lots of students.” Thus, both more and less skilled comprehenders immediately experienced interference caused by the activation of the inappropriate forms of the homophones. After a delay of 1000 ms, the more skilled comprehenders no longer showed interference but the less skilled comprehenders did. It was concluded that less skilled comprehenders were less able to quickly suppress the inappropriate forms of homo-phones.

In yet another experiment (Gernsbacher & Faust, 1991, Experiment 3) less skilled comprehenders were less able to quickly suppress the activation of a related picture when they were reading a word, and they were less able to quickly suppress the activation of a related word when they were viewing a picture. In this experiment participants first viewed a *context display* which contained a word superimposed on a line drawing of a common object, for instance, the word MONTH superimposed on a picture of a broom. Prior to viewing each context display, the participants were told either to focus on the word and ignore the line drawing or to focus on the line drawing and ignore the word. (Indeed, the participants were strongly encouraged to ignore the to-be-ignored item; they were told that the task would be much easier if they did ignore to the to-be-ignored item.) After viewing each context display, the participants were shown a *target display*. Each target display contained either a word or a line drawing. If the trial was one in which the participants were to focus on the word in the context display and ignore the line drawing, the target display also contained a word, and the participants’ task was to decide whether the two words were related. If the trial was one in which the participants were to focus on the line drawing in the context display and ignore the word, the target display also contained a line drawing, and the participants’ task was to decide whether the two line drawings were related.

Both more and less skilled comprehenders immediately had difficulty rejecting a target display if it contained a word that was related to the to-be-ignored line drawing (e.g., rejecting the word SWEEP as not being related to the word MONTH when SWEEP was superimposed on a line drawing of a broom, as opposed to a line drawing of a sandwich). However, after a 1000 ms delay, only the less skilled comprehenders continued to show interference from the should-be-ignored picture.

This pattern of everyone experiencing immediate interference, regardless of comprehension skill, followed by attenuated interference for more skilled comprehenders, is the basis of the claim for group differences in suppression skill. Moreover, this pattern has been replicated by colleagues around the world with whom stimuli have been shared. For example, Twilley and Dixon (1997) at the University of Alberta replicated this pattern using our measure of comprehension skill. Long, Seely, and Oppy (1997) at the University of California, Davis replicated this pattern testing university students who scored high or low on the Nelson-Denny Test. H. Shulman (personal communication, November, 1996) at Ohio State replicated this pattern testing participants who scored in the top versus bottom half of the verbal (but not the math) subtest of the American College Test. F. Pazzaglia and her colleagues (personal communication, July, 1994) at the University of Padova replicated this pattern using Italian homonyms and Italian participants. In his master's thesis Crane (1993) at Washington State University replicated this pattern testing university students with small versus large reading spans. The pattern was also replicated in testing United States Air Force recruits (Gernsbacher & Faust, 1995).

Furthermore, this pattern occurred when members of other populations who hypothetically suffer from less efficient suppression were compared with members of populations hypothesized to have more efficient suppression. For example, using the same stimuli as Gernsbacher et al. (1990, Experiment 4, the “dug with the spade” reject ‘ACE’ stimuli). Faust, Balota, Duchek, Gemsbacher and Smith (1997) found that patients with severe senile dementia of the Alzheimer's type showed extraordinarily inefficient suppression compared with patients with only moderate dementia and healthy age-matched controls. Indeed, these data show something of a dosing effect: The more severe the dementia, the more inefficient the suppression. Using the same stimuli, J. M. McDowd and her colleagues (personal communication, August, 1995) found that healthy elderly participants showed less efficient suppression compared with college-aged participants. E. Schaunessy (personal communication, January, 1993) found that children diagnosed with attention deficit disorder showed less efficient suppression compared with children not diagnosed with attention deficit disorder. Tompkins, Baumbaertner. Lehman, and Fossett (1997) found that adults with right-hemisphere damage showed less efficient suppression compared with age-matched participants without known neurological impairment.

In all the data reviewed, all participants showed initial interference, which is crucial for defining suppression. Furthermore, in all cases, the members of the population that were hypothesized to suffer from less efficient suppression showed continued interference. Although it is tempting to conclude that all of these situations reflect a similar deficit in suppression skill, further empirical investigation is required.

Gernsbacher & Faust (1991) discovered, however, that less versus more skilled comprehenders were not less able to reject the contextually inappropriate meanings of homonyms just because they did not know what was appropriate. Less skilled comprehenders performed as well as more skilled comprehenders when the task was to accept the appropriate meaning of a homonym, for example, when their task was to correctly say yes that the test word ACE was related to the sentence, “He dealt the spade.” Thus, the group differences appear to be attributable to our putative mechanism of suppression (of

inappropriate or irrelevant information), not enhancement (of appropriate or relevant information).

WHEN LESS IS STILL WORSE

Together these experiments suggest that less skilled comprehenders are less able to suppress inappropriate information. However, these experiments, and in particular the ones that use homonyms in their stimuli, lead to a rather unintuitive prediction: If less skilled comprehenders are less able to suppress the inappropriate meanings of homonyms, then - ironically_ less skilled comprehenders might be better than more skilled comprehenders at understanding puns. To understand a pun such as “Two men walk into a bar and the third man ducks,” one has to keep activated the inappropriate meaning of the word *bar* - the meaning not implied by the typical joke scenario of two men walking into a tavern. But intuition suggests that more skilled comprehenders should be more skilled at comprehending puns. Research directly tested this intuition (Gernsbacher & Robertson, 1995).

We developed a task that measured how quickly more versus less skilled comprehenders could identify a meaning of a homonym that was not implied by the immediate context. Participants were told that they would read a series of sentences, and following each sentence they would see a test word on which they would make a judgment. There were two tasks that all participants performed, and the two tasks were separated into two blocks.

For one task, participants judged whether the test word was related to a meaning of the final word of the sentence, but that meaning was not the meaning implied by the sentence. So, for example, after reading the sentence, “He dug with the spade,” if participants were tested with the word ACE they should have responded yes, because ACE is related to one meaning of *spade*, but ACE is not related to the meaning of spade that is implied in “He dug with the spade.” In the block of trials for which participants performed this task, there were 20 trials such as this, in which the correct response was yes (i.e., the test word was related to a meaning of the sentence-final word, but not related to the meaning implied by the sentence). In the block of trials for which participants performed this task, there were also 20 trials in which the correct answer was *no*. On half of those trials, the test word was unrelated to both the sentence-final word and the sentence itself, as the word ACE is to the sentence, “He dug with the shovel.” For the remaining half of the trials in this block for which the correct answer was no, the test word was related to one meaning of the sentence-final word, but that was the meaning implied by the sentence, as the word ACE is to the sentence, “He dealt the spade.”

Therefore, in one block of trials, there were 40 trials in which participants performed the task in which they judged whether the test word was related to a meaning of the sentence-final word, but not the meaning implied by the sentence. On 20 of those trials, the correct answer was yes because the test word was related to one meaning of the sentence-final word, but that was not the meaning of the sentence-final word implied by the sentence. On the other 20 of the 40 trials, the correct answer was no because either the test word was unrelated to both the sentence-final word and the sentence, or because the test word was related to both the sentence-final word and the sentence.

For a comparison, we also measured participants' performance on a different task that was more straightforward. For this second block of trials, the participants judged whether the test word was related to the sentence-final word and related to the meaning of the sentence. This task is similar to those reviewed at the beginning of this paper, although in our previous experiments we simply told participants to judge whether the test word "fit the meaning of the sentence."

In the block of trials for which participants performed this second task, there were 20 trials for which the test word, like ACE, was related to the sentence-final word and related to the sentence per se, for example, "He dealt the spade." There were also 20 trials for which the correct answer was no. On half of those trials, the test word was unrelated to either the sentence-final word or the sentence itself, as the word ACE is to the sentence, "He dug with the shovel." And for the remaining half of the trials for which the correct answer was no, the test word was related to a meaning of the sentence-final word but that was not the meaning implied by the sentence, for example, the test word ACE following the sentence, "He dug with the spade."

We tested 40 more skilled and 40 less skilled comprehenders, whom we selected on the basis of their performance on the multimedia comprehension battery. Half the participants of each skill level completed a block of 40 trials performing one task first, and then a block of 40 trials performing the other task, and we counterbalanced the order of the two blocks. Participants were unaware that there would be a second block of trials, and hence a second type of task, until they completed the first block of trials. Therefore, they were not given the instructions for a second task until they had completed all the trials performing one task. During the entire experiment, each test word was presented at a long delay – 1000 ms after its sentence disappeared. Participants practiced on 20 sentences using the task they would be performing for that block. During the experiment, they were given feedback after each trial as to whether their responses to each test word were correct or incorrect. We analyzed data only from participants who performed with greater than 70% accuracy.

Of primary interest was participants' performance on the trials for which they should have responded yes; these trials demonstrated participants' ability to accept inappropriate meanings and their ability to accept appropriate meanings. When the task required correctly accepting test words related to the inappropriate meanings (i.e., respond yes that a test word was related to a meaning of the sentence-final word but not related to the sentence, for example, responding yes to ACE after reading the sentence, "He dug with the spade"), the less skilled comprehenders responded significantly less rapidly (M = 1235 ms, SE = 45 ms) than did the more skilled comprehenders (M = l047 ms; SE = 44 ms). These data suggest that less skilled comprehenders are not more able to correctly accept inappropriate meanings (as one has to do to comprehend a pun).

In contrast, when the task was to correctly accept an appropriate meaning of a homonym (i.e ., respond yes that a test word was related to the sentence-final word and was related to the sentence), the two skill groups' response times did not differ reliably (M = 914 ms, SE = 38 ms for the less skilled; and M = 865 ms, SE = 34 ms for the more skilled). This finding replicates our previous work that showed that more versus less skilled comprehenders do not

differ on a task where they have to identify the appropriate meanings of homonyms (i.e., there are not any pronounced group differences attributable to our putative mechanism of enhancement).

This last result, as well as others from our laboratory and others' laboratories, opposes a *general slowing account* of group differences in suppression skill. We and others have found that poorer comprehension – and by extension, suppression – skill is not always manifested in slower response times on our laboratory tasks. As in the data just reviewed, the less versus more skilled comprehenders' response times differed on one task (when the task was to accept the inappropriate meanings of homonyms) but not another task (when the task was to accept the appropriate meanings of homonyms). Note that these data are not difference scores but "raw" reaction times; thus the interpretation is not prone to the problems inherent with difference scores.

Although response times differed between the two skill groups on one task, but not on the other, participants in the two skill groups did not differ in their accuracy on the two tasks. Their accuracy rates were 85% and 84%, for the more versus less skilled comprehenders, when the task was to correctly accept an appropriate meaning of a homonym and their reaction times differed, and 93% and 91% for the more versus less skilled comprehenders when the task was to accept the appropriate meanings of homonyms and their reaction times did not differ. Thus, the interaction we found for response time did not result from a speed-accuracy trade-off.

Neither did the interaction appear to be a scaling artifact, such that the slower the average response time the larger the difference between the two groups. When we examined a type of trial on which participants in both skill groups responded an average 150 ms slower (viz., no items in the related-to-word-not-related-to-sentence task) than they responded on the type of trial for which we found group differences (viz., yes items in the related-to-word-not-related-to-sentence task), the difference between the two groups nonetheless remained around 200 ms (M = 1298 ms for the less skilled, M = 1096 ms for the more skilled). In other words, even when both groups responded an average 200 ms more slowly, the difference between the two grou$_{ps}$ was not (proportionately) larger.

Similarly, when we examined a type of trial on which both skill groups responded an average 100 ms more slowly than they responded on the type of trial for which we did not find group differences (viz., yes items in the related-to-word-and-related-to-sentence task), the difference between the two groups was even smaller (M = 1011 for the less skilled. M = 974 for the more skilled), and still statistically unreliable. Thus, even when both groups responded 100 ms more slowly, the difference between the two groups was smaller.

Why do more versus less skilled comprehenders differ in their speed at accepting inap - propriate meanings but not their speed at accepting appropriate meanings7 We know that less skilled comprehenders do not have difficulty activating appropriate meanings. We saw evidence of this in the current experiment, and have reported other evidence of this in our previous work. Indeed, sometimes less skilled comprehenders tend to hyperactivate contextually appropriate information. We also know that less skilled comprehenders do not

have difficulty activating inappropriate meanings. Indeed, in our previous experiments, inability to quickly suppress the inappropriate meanings was the less skilled comprehenders' Achilles heel. We replicated that finding in the current experiment on the trials in which participants had to say no that ACE was not related to the sentence, "He dug with the spade." Perhaps the problem is suppression and perhaps in order to quickly accept an inappropriate meaning, participants need to quickly suppress the appropriate meaning.

Support for this hypothesis was provided in the same data set (Gernsbacher & Robertson, 1995). In the block of trials for which the participants' task was to judge whether a test word was related to the sentence-final word but not related to the sentence there was a type of trial for which participants had to say no to the appropriate meaning. For example, they had to reject the test word ACE following the sentence. "He dealt the spade." To respond correctly to these trials, that is say no, participants need to reject the appropriate meaning, and again we observed a dtfference between the more versus tess skilled comprehenders. Indeed, the less skilled comprehenders again responded more slowly than the more skilled comprehenders on this type of trial, when they had to reject or suppress an appropriate meaning. The difference was just as great as when they had to accept an inappropriate meaning. Thus, less skilled comprehenders' greater difficulty in accepting an inappropriate meaning might be due to their greater difficulty in suppressing an appropriate meaning, the point being that groups differ in suppression skill.

WHEN LESS IS BETTER

Perhaps there are situations in which a reduced ability to suppress inappropriate information is actually adaptive. One of these situations was identified recently (Gernsbacher & Robertson, 1997). Participants in these experiments read a series of seemingly unrelated sentences. Each sentence was of the form pronoun, verb, noun phrase, and the sentence-final noun phrase comprised a determiner plus a homonym, for example, "the match". The participants' task was to read each sentence and decide whether it made sense. Half the sentences did make sense, as in "She lit the match", and half the sentences did not make sense, as in "She prosecuted the match".

Unknown to the participants, the list of 384 sentences included 24 pairs of experimental sentences. We called these sentences *experimental pairs* because the first sentence of each pair was our prime sentence, and the second sentence of each pair was our target sentence. We manipulated the prime sentences and measured the effect of our manipulation on participants' responses to the target sentences. For example, the target sentence, "She blew out the match", was preceded by one of three prime sentences. In the same-meaning prime condition, the prime sentence implied the same meaning of the homonym that the target sentence implied, as in the prime sentence, "She lit the match", preceding the target sentence, "She blew out the match". In the neutral-meaning prime condition, the prime sentence was uninformative about the meaning of the homonym, as in the prime sentence, "She saw the match", preceding the target sentence, "She blew out the match". In the different-meaning prime condition, the prime sentence implied a different meaning of the homonym than the target sentence implied, as in the prime sentence, "She won the match", preceding the target sentence, "She blew out the match".

We considered participants' responses to target sentences after they read neutral prime sentences as a baseline, and we predicted that participants would reap a benefit from reading a prime sentence that implied the same meaning of the homonym as the meaning implied by the subsequent target sentence. We also predicted that participants would incur a cost from reading a prime sentence that implied a different meaning of the homonym as implied by the subsequent target sentence. Indeed, that is what was observed. By subtracting participants' response times to target sentences after they read same-meaning primes (*M* = 1107 ms, *SE* = 29 ms) from their response times to target sentences after they read neutral-meaning primes (*M* = 1195 ms, *SE* = 35 ms), we quantified the amount of benefit that participants reaped; a statistically reliable 88 ms. By subtracting participants' response times to target sentences after they read neutral-meaning primes (*M* = 1195 ms, *SE* = 35 ms) from their response times to target sentences after they read different-meaning primes (*M* = 1281 ms, *SE* = 41 ms), we quantified the amount of cost that participants incurred; a statistically reliable 86 ms.

We also quantified these costs and benefits using participants' error rates. By subtracting participants' error rates on target sentences after they read same-meaning primes (*M* = 11%. *SE* = 1%) from their error rates on target sentences after they read neutral-meaning primes (*M* = 17%, *SE* = 2%), we quantified the amount of benefit that participants reaped; a statistically reliable 6%. By subtracting participants' error rates on target sentences after they read neutral-meaning primes (*M* = 17%, *SE* = 2%) from their error rates on target sentences after they read different-meaning primes (*M* = 25%. *SE* = 2%). we quantified the amount of cost that participants incurred; a statistically reliable 8%.

We included participants' data only if they responded correctly to both the prime sentence and its subsequent target sentence. On average, participants made 9% of their errors on the prime sentences; however, there were no differences in how frequently participants responded incorrectly to the same-meaning, neutral-meaning, or different-meaning primes (although, of course, there were differences in how accurately participants responded to the targets in these three conditions).

Why are these benefits reaped and these costs incurred? I assume that after participants comprehend the sentence, "She lit the match," the firestick meaning of match is enhanced, and the contest meaning is suppressed. After participants comprehend the sentence, "She won the match," the contest meaning of *match* is enhanced, and the firestick meaning is suppressed. But after participants comprehend the sentence, "She saw the match," neither the fires tick nor the contest meaning is enhanced or suppressed. When participants subsequently read the sentence, "She blew out the match," they need the firestick meaning. If that meaning has been enhanced, then participants will reap a benefit. But if that meaning has been suppressed, then participants will incur a cost.

It was proposed that when participants comprehend the neutral primes neither one meaning is enhanced nor the other meaning is suppressed. An alternative explanation is that for each neutral sentence prime, approximately half of the participants enhanced one meaning, and the other half enhanced the other meaning, with the net result being that average response times and error rates to the target sentences following the neutral primes would be halfway

between the response times and error rates in the same- versus different-meaning conditions. This is exactly what we observed.

When reading a target sentence after reading a neutral prime, if half the participants were (in the above terms) reaping a benefit and half were incurring a cost, then neutral prime condition should be associated with more variance. How ever, the average of each participant's standard deviation of his/her response time was not larger in the neutral-meaning prime condition than in the same- or different-meaning prime conditions. The same was true when we investigated each item's standard deviation.

In our second experiment we employed a corroborating baseline that also demonstrated equivalent costs and benefits of meaning. In this experiment, we again preceded each target sentence by one of three prime sentences. Our same-meaning primes and different-meaning primes were identical to those of our first experiment. However, instead of manipulating a neutral-meaning prime as our baseline condition, we manipulated a no-meaning prime, for example, “She prosecuted the match.” We verified that at least 90% of our participants in a norming study confirmed that each no-meaning prime sentence did not make sense, but when pressed to say what meaning the sentence could imply, even though it didn't make sense, no one individual meaning was selected for each sentence by more than 60% of the participants.

Using participants’ responses to the target sentences in the no-meaning condition as a baseline, we quantified the benefit that participants reaped, a reliable 66 ms and 7%, and we quanti-fled the cost that participants incurred, a reliable 127 ms and 8%. These costs are incurred because when participants read the prime sentences, they suppress the meanings that they do not need. If they later read a target sentence that implies a meaning which they have suppressed, as they did in the different-prime condition, they will be slower and less accurate.

This explanation of costs and benefits in terms of suppression and enhancement leads to an interesting prediction regarding group differences in suppression skill. Previously we discovered that less skilled comprehenders are characterized by less efficient suppression. At the same time, we observed that less skilled comprehenders are not characterized by less efficient enhancement. Indeed, the enhancement effects that we observed for less skilled comprehenders are equivalent to those of more skilled comprehenders. Thus, although less skilled comprehenders are characterized by less efficient suppression, they demonstrate enhancement equally efficient to that of more skilled comprehenders. Because less skilled comprehenders are characterized by less efficient suppression, if these costs are due to suppression, then less skilled comprehenders should incur fewer costs than more skilled comprehenders incur. In contrast, because less skilled comprehenders demonstrate equally efficient enhancement, if these benefits are due to enhancement, then less skilled comprehenders should reap benefits equivalent to those reaped by more skilled comprehenders.

We tested these predictions by selecting 32 more skilled comprehenders, who scored higher than 75% on the written version of our multimedia comprehension battery (Gernsbacher &

Varner, 1988), and 32 less skilled comprehenders, who scored lower than 70% on the comprehension test. We tested these more versus less skilled comprehenders on the experiment just described. The more skilled comprehenders reaped a reliable 70 ms-6% benefit, and they incurred a reliable 118 ms-5% cost. The less skilled comprehenders also reaped a reliable 97 ms-9% benefit; however, they incurred very few costs. Their 10 ms-1 % cost was not statlStlcally reliable. These data support the hypothesis that the costs incurred by reading a different-meaning prime are due to suppression; less skilled comprehenders, who are characterized by less efficient suppression, incur fewer costs.

How long do these costs and benefits of meaning last? We explored that question by presenting half the prime sentences immediately before their respective target sentence, as done before, and presenting half the prime sentences five sentences before their respective target sentence. The results demonstrated that when the prime sentences immediately preceded the target sentences, as they did in our previous experiments, participants again reaped a reliable 88 ms-8% benefit, and they incurred a reliable 77 ms-4% cost. When the prime sentences preceded the target sentences by five sentences, participants also reaped a reliable 53 ms-7% benefit: however, they did not incur a reliable cost when measured by either their response time or their error rate. We observed the same lack of cost but persistence of benefit in another experiment in which the prime sentences preceded the target sentences by seven sentences. These experiments demonstrate another situation in which these costs and benefits of meaning are dissociated. The costs are relatively quick lived, but the benefi last longer.

These dissociations of costs and benefits are not simply due to a ceiling effect. If we examine the data from the slowest third of the participants in our first experiment, we realize that even participants whose response times were an average 100 ms slower in the baseline condition than any of the means shown so far, still incurred a reliable 149 ms-9% cost. Similarly, when we examine the data from the slowest third of the participants in our second experiment, we realize that although their response times ranged into 1500 ms, they still incurred a reliable 134 ms-6% cost. Thus, the dissociation between costs and benefits that we observed for comprehension skill and for the distance between the primes and targets are most likely not due to a ceiling effect.

These dissociations suggest that these costs and benefits are not due to *episodic retrieval*. According to an episodic retrieval explanation, when participants read each prime sentence, they neither suppressed nor enhanced any meaning. When they later read a target sentence that was similar to a prime sentence, they were reminded of the prime sentence. To the degree that the target sentence matched participants' memory of the prime sentence, they were facilitated or impeded in responding to the target sentence. However, an episodic retrieval explanation would have to posit that our participants' memory of different-prime sentences faded more quickly than their memory of same-prime sentences, and that our less skilled comprehenders had poorer immediate memory of only the different-prime sentences. Given that participants did not know when they read each sentence whether a later sentence would imply the same or a different meaning, the following can be concluded.

The benefits observed in these experiments are due to enhancement; the costs observed are due to suppression. When participants read a sentence that contains a homonym they suppress the meaning that is not implied by the sentence. When they later read a sentence that implies that previously suppressed meaning, they incur a cost. It can also be concluded that the costs incurred by suppressing an irrelevant meaning are relatively quick lived, whereas the benefits reaped by enhancing a relevant meaning last longer. Finally, with regard to group differences in suppression skill, less skilled comprehenders, presumably because they are characterized by less efficient suppression, incur little cost but reap equivalent benefits. Thus, a situation in which compromised suppression skill is advantageous has been identified.

It will be interesting to see whether other groups who exhibit inefficient suppression in the other laboratory task that we pioneered – for instance, children diagnosed with attention deficit disorder, adults with right-hemisphere damage, and most relevant to the current volume, aging adults – also show benefits in this laboratory task in which compromised suppression pays off. Moreover, it will be interesting to see if research can identify other situations in which group differences in suppression skill are advantageous. I believe that in most of life's demands, members of groups characterized by inefficient suppression will be plagued by an embarrassment of riches.

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