broken DNA ends (*22*, *23*). Furthermore, PARP1 is required for an alternative, DNA–dependent protein kinase catalytic subunit (PK_{cs}) independent pathway of NHEJ (*24*, *25*). Overexpression of SIRT6 in DNA-PK_{cs} null MEFs up-regulated NHEJ by 1.7-fold, and in the WT MEFs by 2.3-fold (fig. S12), suggesting that SIRT6 stimulates the alternative NHEJ pathway.

In this study, we identify PARP1 as the in vivo target of SIRT6 ribosylation. As PARP1 is involved in both BER and DSB repair (*17*, *26*), the role of SIRT6 as an activator of PARP1 explains the phenotype of the SIRT6 knockout mice, which are characterized by deficient BER and genomic instability probably stemming from a defect in DSB repair (*6*). In the absence of oxidative stress, SIRT6 overexpression mildly induced repair, whereas under stress DNA repair was stimulated up to 16-fold. This observation suggests that SIRT6 plays a regulatory function in DNA repair by integrating DNA repair and stress signaling pathways.

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The Visual Impact of Gossip

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Gossip is a form of affective information about who is friend and who is foe. We show that gossip does not influence only how a face is evaluated—it affects whether a face is seen in the first place. In two experiments, neutral faces were paired with negative, positive, or neutral gossip and were then presented alone in a binocular rivalry paradigm (faces were presented to one eye, houses to the other). In both studies, faces previously paired with negative (but not positive or neutral) gossip dominated longer in visual consciousness. These findings demonstrate that gossip, as a potent form of social affective learning, can influence vision in a completely top-down manner, independent of the basic structural features of a face.

Gossip is a vital thread in human social interaction. As a type of instructed learning, gossip is a way to learn socially relevant information about other people's character or personality without having to experience directly their triumphs and misadventures (*1*). Whether delicious or destructive, gossip is functional. It provides human beings with information about others in the absence of direct experience, allowing us to live in very large groups. It is believed that gossip was important for social cohesion during the course of human evolution (*2*). Scientists speculate that instead of establishing and maintaining relationships by plucking fleas off of each other, we exchange and digest juicy tidbits of chit-chat, hearsay, and rumor. Gossip allows human beings not only to transcend one-to-one interaction for getting along and getting ahead, but also to know the "value" of people we have never met. For instance, perceivers evaluate a structurally neutral face (presented alone) as "negative" for as long as 2 days after that face was paired only four times with a sentence describing a negative behavior (e.g., "threw a chair at a classmate") (*3*). Gossip, when understood as a type of instructed affective learning, is a powerful way to learn whom to befriend and, even more important, whom to avoid—all without the costly and time-consuming process of learning from firsthand experience.

To assess how gossip might influence conscious visual experience for other people, we capitalized on a phenomenon known as binocular rivalry (*4*). Binocular rivalry occurs when perceptually dissimilar images are presented to different eyes (e.g., a face to one eye and a house to the other eye) and the two percepts compete for perceptual dominance. Visual input from one eye is consciously experienced (and seen) while

Fig. 1. Example of gossip stimuli. Examples of structurally neutral faces paired with one of the following: (**A**) negative gossip; (**B**) positive gossip; (**C**) neutral gossip; (**D**) negative nonsocial information; (**E**) positive nonsocial information; (**F**) neutral nonsocial information. For a complete list of sentences, see (*26*).

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the visual input from the other eye is suppressed (and remains unseen). After a period of a few seconds, the suppressed image becomes dominant (and the formerly dominant image becomes suppressed), so that over time people experience the two percepts alternating. Neuroimaging and psychophysiological studies indicate that rivalry depends on competitive interaction at multiple neural sites and at different levels of processing (*5*). By measuring the length of dominance durations, it is possible to determine which visual input the brain is selecting for conscious experience. Dominance is influenced by stimulus properties (i.e., "bottom-up" properties), such as luminance (*6*), contrast (*7*, *8*), contour density (*9*), spatial frequency (*10*), and configural properties (*11*). Furthermore, rivalry resolution (which object is dominant and which is suppressed) occurs largely independently of controlled attention (*12*), although a node within the dorsal attention network (the intraparietal sulcus) (*13*) helps to resolve rivalry between two images (*14*); other forms of top-down influence, such as imagery (*15*), skilled meditation (*16*), and associative learning to elective shock (*17*) can increase dominance durations, and at times, personality traits (e.g., general anxiety) can increase the alternation rate [(*18*) but see (*19*, *20*)].

There are a number of experiments demonstrating that images with overt affective value (such as startled "fearful" faces, disgusting pictures, etc.) dominate in binocularly rivalry over affectively neutral images (*21*, *22*). However, more affectively potent images can differ in their physical properties when compared with neutral images (*23*, *24*), which makes it difficult to infer that affective value per se was influencing which information is selected for consciousness. Furthermore, in most studies, perceivers were asked to indicate whether they see an emotional or neutral object, and task instructions can serve as a context to bias how sensory information is selected (*25*). The present experiments were not vulnerable to these concerns, however, because the physical properties of structurally neutral faces were held constant across all conditions, whereas the affective value of the faces was modified through participants' prior affective learning.

We used an established affective learning procedure (*3*) in which participants were presented with structurally neutral faces that were paired with descriptions of behaviors (Fig. 1) (*26*). In study 1, participants were presented with neutral faces that were paired four times with a description of a negative social behavior (e.g., "threw a chair at his classmate"); a positive social behavior (e.g., "helped an elderly woman with her groceries"); or a neutral social behavior (e.g., "passed a man on the street"). To test whether there was something special about learning the kind of social information about a person that is most typical of gossip (as opposed to more general affective learning about information that is less relevant to judgments of a person's character or personality), study 2 participants were also presented with faces that were paired four times with description of either social or nonsocial information (e.g., nonsocial negative, "had a root canal performed"; nonsocial positive, "felt the warm sunshine"; nonsocial neutral, "drew the curtains in the room"). All faces were structurally neutral and were counterbalanced in their pairings with descriptions across participants. Participants then proceeded directly to the binocular rivalry task, where a mirror stereoscope was used to create binocular rivalry conditions; on each trial a structurally neutral face (previously paired with negative, neutral, or positive information, or a novel neutral face) was presented to one eye and a house to the other (eye presentation was counterbalanced across trials) (Fig. 2). Novel neutral faces were included to assess whether dominance was in part due to the mere exposure effect of previously presenting faces. Using a standard computer keyboard, participants pressed one key for the duration that they consciously experienced seeing a house and a different key for the duration when they saw a face. In both studies, affective learning was tested for the faces (after the binocular rivalry task, study 1, and before the binocular rivalry task, study 2) by asking participants to explicitly rate the faces (presented alone) as negative, neutral, or positive. To control for potential disparities in affective learning of the different types of stimuli, study 2 participants first performed a learning test (that is, they had to explicitly categorize the faces on the basis of the sentences they had been previously paired with) (*26*) where they had to demonstrate a minimum of 60% accuracy before they could proceed to the binocular rivalry phase. The different learning procedure in study 2 ensured that relatively equal learning occurred for all types of stimuli before their visual dominance was tested.

In study 1, structurally neutral faces previously paired with gossip of negative behaviors were selected for consciousness and dominated in visual awareness significantly longer than did all other neutral faces, including novel neutral faces that were presented for the first time during binocular rivalry (Table 1). A repeated-measures analysis of variance, with face dominance time as the dependent variable and gossip valence as the repeated measure (faces previously paired with negative, neutral, or positive sentences, as well as novel faces) was statistically significant ($F_{3,165}$ = 3.04, $P < 0.032$). Follow-up *t* tests revealed that neutral faces previously paired with negative gossip were seen for longer durations than were faces previously paired with neutral gossip [$t(56)$ = 2.10, $P < 0.041$] or positive gossip [$t(55) = 2.40$, $P < 0.019$]. Neutral faces previously paired with negative gossip were also seen longer than novel, neutral faces [$t(57) = 2.20$, $P < 0.031$]. There was no difference in mean face dominance duration for neutral faces previously paired with positive or neutral gossip nor between these faces and the novel faces never paired with gossip. Gossip also did not influence the duration for which faces were suppressed (and houses were dominant) ($F_{3,153}$ = 0.79, $P < 0.501$); the first percept seen (house or face) ($F_{3,195}$ = 0.53, $P <$ 0.66); or the number of percepts visible per trial ($F_{3,195}$ = 1.02, $P <$ 0.387). On average, there was no relation between face dominance and explicit judgments of those faces across participants (fig. S1). Our

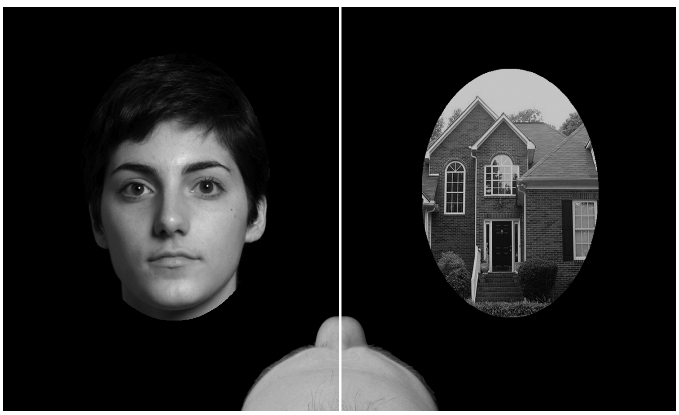

Fig. 2. Depiction of a trial in the binocular rivalry task. In the binocular rivalry task, a neutral face was presented to one eye and a house to the other.

Table 1. Mean face dominance durations in ms. Standard errors are given in parentheses. Each trial lasted 10,000 ms. In study 1, the participants (*n*) in each cell ranged from 58 to 61 as some participants did not have data for each cell. In study 2, *n* ranged from 35 to 41.

	Sentence type	Face dominance duration (ms)
Study 1		
	Negative	4861 (380)
	Neutral	4340 (361)
	Positive	4348 (354)
	Novel	4310 (337)
Study 2		
Social	Negative	2507 (361)
	Neutral	2102 (259)
	Positive	1983 (266)
Nonsocial	Negative	1649 (163)
	Neutral	1769 (179)
	Positive	1736 (184)
	Novel	1942 (184)

finding that faces previously paired with negative social information dominate in rivalry is consistent with other research showing that unpleasant stimuli capture attention (*27*), improve visual search efficiency (*28*), and improve contrast discrimination (*29*).

One possible interpretation of our findings from study 1 is that participants simply learned the negative information better than the neutral or positive information; this would be consistent with research showing that negative information is more easily and quickly learned than other types of information (*2*). Another possibility is that our finding reflected the power of instructed affective learning, more generally, as opposed to something particular concerning the instructed learning about socially relevant material that is characteristic of gossip. In study 2, we controlled for these possibilities by having participants learn to a criterion and learn to pair neutral faces with nonsocial affective sentences. If there was something special about negative gossip, then structurally neutral faces paired with it would dominate in rivalry over all other neutral faces, even as we controlled for differences in learning.

In study 2, we confirmed that the visual dominance of faces paired with negative gossip was not a function of more general (nonsocial) affective learning (Table 1). A planned doubly centered contrast (*30*) was statistically significant ($F_{2,48}$ = 7.16, P < 0.002), such that faces previously paired with negative gossip (i.e., negative social sentences) dominated in visual consciousness longer than did any other structurally neutral faces (including those that were previously paired with nonsocial, negative information). Neutral faces previously paired with negative gossip were also seen longer than novel neutral faces [$t(40)$ = 2.40, P < 0.03]. These findings show that structurally neutral faces that have acquired negative value by gossip are visually salient even when we control for learning rates, so that differential learning cannot account for the failure to observe an increase in visual dominance for neutral faces paired with positive information in both experiments (*26*).

In sum, hearing that a person stole, lied, or cheated makes it more likely that a perceiver will consciously see that structurally neutral, but purportedly villainous, face. Faces previously paired with descriptions of negative social behaviors were prioritized for consciousness as measured by longer dominance durations in binocular rivalry than were faces paired with other gossip or valenced, nonsocial information. It is easy to imagine that this preferential selection for perceiving bad people might protect us from liars and cheaters by allowing to us to view them for longer and explicitly gather more information about their behavior.

We demonstrated that negative gossip influences vision for structurally neutral faces in a completely top-down manner. Previous studies examining the affective influence on visual consciousness have attempted to control for the fact that positive and negative faces differ in their visual properties (*19*) or have paired electric shock with identical stimuli to provide them with affective value using associative conditioning (*17*). Our study is the first to completely rule out concerns about inconsistent visual properties while preserving the social relevance of faces and also showing that social learning is a potent means to change the visual salience of a target person. This finding is consistent with neuroanatomical evidence that affect is a source of attention in the brain that directly and indirectly modulates the firing of neurons in visual cortex via a variety of pathways [for reviews, see (*31*, *32*)]. However, the data presented in this paper do not directly test any specific neutroanatomical hypothesis.

Of course, negative gossip is one way to acquire information about another person. Other types of social learning exist (e.g., observational learning) and result in associations that are equivalent to classical conditioning, where perceivers watch another person experience electric shock that is repeatedly paired with neutral face (*33*). It is an open question whether observational learning or other types of social learning have top-down effects on visual consciousness, however.

Finally, our findings contribute to the growing scientific evidence that visual sensations from the world alone are not sufficient for conscious visual experiences. Top-down (i.e., perceiver-based) influences are crucial to make sense of the world with "late" perceptual brain areas helping to modulate "early" areas (*34*, *35*). Our results contribute a new avenue to this work by showing that top-down affective information acquired through gossip influences vision, so that what we know about someone influences not only how we feel and think about them, but also whether or not we see them in the first place.

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