

THE HISTORICAL ORIGINS OF PRIMING AS THE PREPARATION OF BEHAVIORAL RESPONSES: UNCONSCIOUS CARRYOVER AND CONTEXTUAL INFLUENCES OF REAL-WORLD IMPORTANCE

John A. Bargh
Yale University

Contrary to the recent assertions of skeptics of behavioral priming effects, the concept of priming was not introduced by the Meyer and Schvaneveldt (M-S, 1971) study of brief semantic spreading activation effects (perceptual-interpretation priming); it was originally introduced by Karl Lashley (1951) as a mechanism to increase the probability of a behavioral response (behavioral priming). The priming of the response was Lashley's solution to the problem of smooth behavioral response sequencing. Moreover, the initial priming demonstrations in experimental psychology, which predated M-S by many years, were of carryover effects from one experimental task to another—the same priming paradigm commonly employed in social psychology since the pioneering study of Higgins, Rholes, and Jones (1977). These priming effects were thus of considerably longer duration than the fleeting spreading activation effects obtained by M-S in the lexical decision task. Priming and accessibility effects of which the individual is unaware are commonplace in tasks involving higher mental processes, across diverse areas of psychological research, and often take the original form of carryover effects of task or emotional state to an unrelated subsequent context. In addition, behavioral priming is a natural and ecological phenomenon, as imitation and mimicry effects of perceiving another's behavior on one's own behavioral tendencies are clear manifestations of behavioral priming effects in the real world. These and other natural priming effects have now been demonstrated to have practical and applied importance in everyday life, such as in therapeutic interventions for addictions, increasing production in the workplace, and providing useful and effective “nudges” to a happier and healthier life.

Address correspondence to John A. Bargh, Department of Psychology, Yale University, 2 Hillhouse Ave., New Haven, CT 06520; E-mail: john.bargh@yale.edu

Priming effects are driven by the natural contact of external environmental stimulation with internal mental representations of those environments, part of the process by which sensation is turned into perception. In an initial “preattentive” or “preconscious” information analysis stage, incoming external stimulation is massively reduced and simplified, and imbued with categorical meaning, prior to one’s becoming consciously aware of the products of this analysis (e.g., Bargh, 1989; Bruner, 1957; Neisser, 1967; Norretranders, 1998). By early childhood, an individual has had enough experience with the physical and social worlds that these analyses, reductions, and categorizations are made automatically, so that the perceptual analyses are experienced directly, without subjective feelings of effort after meaning. The process of sensation thus comes to proceed seamlessly into that of perception, and the results of the effortless analysis experienced, and trusted, as if it were all sensory and “out there,” and the perceiver unaware of the important role played by the internal processing (Jones & Nisbett, 1971).

Understood this way, priming as a psychological principle should be noncontroversial. It occurs constantly and reflects the natural way a human mind keeps in touch with its current environment. What appears to be controversial is the effect of such priming on action, and this may reflect a disagreement over larger issues—the purpose and function of cognition itself. That the mental representations activated (as by primes) in the natural course of perception could also influence ongoing behavior has long been a basic guiding assumption of the research program of Wolfgang Prinz (1997) and colleagues (e.g., Knuf, Aschersleben, & Prinz, 2001). Today, the “pragmatic” movement in cognitive science that he and his students helped to found argues that cognition is not so much for the purpose of making models of the world as it is to subserve action; thus, brain states are not so much representations of the world as functional directives that guide action (Clark, 1998; Engel, Mare, Kurthen, & Koenig, 2013). In social psychology thirty years ago, McArthur and Baron (1983) advanced a similar ecological theory of social perception, based on Gibson’s (1979) ecological theory of visual perception, with its basic premise that “perceiving is for doing,” emphasizing the functional nature of social perception in the service of action preparation. The hypothesis then that behavioral priming, or the temporary activation of schemas containing social behavioral information, can lead directly to action tendencies is in harmony with this pragmatic or “enactive” movement within cognitive science (for more, see Engel et al., 2013; Morsella, Bargh, & Gollwitzer, 2009) although it might be more difficult to reconcile with the more traditional “mental models” meta-view.

Skeptics of behavioral priming effects (e.g., Harris, Coburn, Rohrer, & Pashler, 2013) question the validity of behavioral priming effects in part because the semantic priming studies of Meyer and Schvaneveldt (1971) using a lexical decision task showed only fleeting accessibility effects lasting less than a second (e.g., DOCTOR primes NURSE, OCEAN primes WATER). How then, they argue, can the effects of social or behavioral priming manipulations last so much longer (5 or 10 minutes or so)? In commenting on the behavioral priming effects in social psychology, Harris and colleagues (2013) question whether any priming more complex than that found by Meyer and Schvaneveldt (1971) is possible or even likely:

The function and mechanism of the perceptual priming effects described in the previous paragraph seem relatively straightforward. Signal detection analysis shows that these priming effects reflect a perceptual bias toward assuming that

target information is consistent with the prime . . . Whereas the function of perceptual priming seems easy to understand, as mentioned above, the functional purpose achieved by higher-level priming effects is less obvious. (pp. 1–2)

In an effort to reconcile studies that find versus do not find behavioral priming effects, Klatzky and Creswell (in press) also point to the Meyer and Schvaneveldt (1971) studies as the standard or typical priming effect; in support of this premise, they state at the outset that Meyer and Schvaneveldt were the originators of priming research: “The term *priming* has its origins in research concerned with the spread of activation from one concept or neural site to another (e.g., Meyer & Schvaneveldt, 1971; Dehaene, Naccache, Cohen, et al., 2001). Priming has further been extended to effects on complex behaviors that are often quite distal or remote to the primed concept” (Klatzky & Creswell, in press).

But in fact Meyer and Schvaneveldt (1971) were *not* the originators of the priming concept or priming research. It was Karl Lashley (1951) who originated the concept, and tellingly, he invoked it to explain how *behavioral responses* were prepared by the mind. Moreover, Meyer and Schvaneveldt (1971) did not do the original priming research. The original priming studies used the same carryover (unrelated) task paradigms as did the social priming studies that came later (e.g., Higgins, Rholes, & Jones, 1977) and have the same time scale of priming effect durations as well, with effects lasting 5 or 10 minutes or more, not milliseconds.

In contrast to the pragmatic view of cognition as in the service of preparing adaptive behavioral responses, many cognitive scientists instead assume that the basic, evolved function of cognition is to understand the world and to form accurate mental models of it. This assumption is reflected in the above quote from Harris and colleagues (2013) and is a basis for their contention that longer-term social or behavioral priming effects are implausible. But as the actual history of the priming concept and of priming research in experimental psychology shows, the concept of priming did not originate with Meyer and Schvaneveldt (1971; hereafter “M-S”) and it did not originate in demonstrations of rapid perceptual interpretations of the world.

KARL LASHLEY AND THE ORIGINS OF PRIMING RESEARCH

The term *priming* was first used by Karl Lashley in his 1951 chapter, “The problem of serial order in behavior.” Lashley was dealing with the problem of how serial response sequences, as in speech production, flow so quickly and apparently effortlessly. He argued that there had to be a mediating state intervening between the act of will or intention (to perform an action, to speak a given sentence) and the production of the intended behavior, which assembled the action into the proper serial sequence. This he called the *priming* of the response. In this remarkable paper, Lashley (himself a behaviorist) rejected the then-dominant behaviorist reflex chaining accounts of the sequencing of behavior (ridiculed even more savagely by Koestler, 1967), and argued instead for a more mentalistic account in which behavioral sequences are typically controlled with central (executive) plans. The plans operated through first *priming* the behavioral steps in advance, so that they could roll off smoothly upon production, as in the spontaneous and fluent utter-

ance of a complex, grammatically correct sentence in unrehearsed conversation with another person.

The idea of priming thus entered the experimental psychological literature to refer to a preparedness of mental representations to serve a response function. It did not refer initially to the very rapid and fleeting spread of activation from one mental representation to another. Moreover, the original priming demonstrations were of task carryover effects that lasted a matter of several minutes (similar to those of the original social priming study of Higgins et al., 1977), not a matter of milliseconds.

The discovery of carryover priming effects was actually quite serendipitous. Storms (1958) first gave his participants a list of words to memorize, and then had them free associate to a series of stimulus words. Unexpectedly, Storms found that the words presented in the memory task became more likely than usual to be given as associates (compared to standard free associate norms). Storms reported this effect but could not explain it, concluding that "the mechanisms of this recency effect remain unexplored" (p. 394).

It was Segal and Cofer (1960) who should be credited with the first use of the term *priming* to refer to this effect: the recent use of a concept in one task on the probability of its usage in a subsequent, unrelated task. Segal and Cofer replicated Storms' finding but, critically, without the use of explicit recall instructions—instead, merely exposing participants to the list of words was shown to have the effect of increasing the probability that those words would be used in the subsequent free association task.

Following this initial demonstration, priming began to be used as an experimental technique, especially to show how information had been stored in memory despite the individual's inability to recall it (Grand & Segal, 1966; Koriatic & Feuerstein, 1976; Segal, 1967). That is, words presented in a first task still were more likely than usual to show up as free associates in a subsequent task, even though participants had failed to recall them at the end of the first task. Thus, these early priming studies were the forerunners of the important contemporary distinction between implicit and explicit forms and uses of memory (e.g., Schacter, 1987).

This is the model priming study that Higgins, Rholes, and Jones (1977) followed in their groundbreaking study of carryover effects in impression formation (not the M-S type of priming). They showed that personality trait concepts such as *adventurous* or *independent* could be primed by recent use. Using the same unrelated studies paradigm as had Segal and his colleagues, Higgins and colleagues (1977) exposed participants to synonyms of certain personality traits as part of a first, memory experiment. Next, in what participants believed to be an unrelated experiment, they read about a target person named Donald who behaved in ways ambiguously related to the primed traits, such as sailing across the ocean alone or preferring to study by himself instead of with classmates. Those participants who had been exposed to words such as *adventurous* and *independent* formed more positive impressions of Donald than did participants who had been previously exposed to relevant terms such as *reckless* and *aloof*. Importantly, participants evidenced no awareness of having been influenced by their prior exposure to trait terms in the earlier "memory experiment."

The advance beyond the previous priming studies was that the responses of the Higgins and colleagues' participants did not involve using the prime words themselves, as in the free association studies by Segal and colleagues; instead, they

gave an overall impression or evaluation of Donald. What had been primed was not just the single, concrete lexical memory locations corresponding to the stimulus words, but also the abstract trait concepts themselves. These in turn, because they were primed and more accessible for use in perception (Bruner, 1957), became more likely to capture the relevant but ambiguous behavioral information about Donald, thus slanting final impressions in the positive or negative direction.

The Higgins and colleagues' (1977) study revealed for the first time how an individual's recent experience could affect, in a passive and unintended manner, his or her perceptual interpretation of another person's behavior. In their study, all participants read about the same target person doing the same things, yet they came away from their reading with markedly different impressions of that person, differences that were only accountable by reference to the experimentally manipulated differences in their recent use of different trait concepts.

In all of these studies, and in most of the behavioral priming studies discussed below, priming manipulations involved the recent use of mental concepts in one context that carried over to influence responses in an unrelated context, often several minutes later. This *unrelated-studies paradigm* has been used in many other domains of psychological research to demonstrate carryover effects of one situation or type of experience into subsequent contexts, with the individual unaware of the carryover effect of their recent experience. For example, classic work by Zillman (1978) and associates on "excitation transfer" showed that arousal caused by one context (e.g., a scary movie) could be misattributed in a subsequent context (one's degree of attraction to one's movie date). More recently, Lerner and associates (Lerner & Keltner, 2001; Lerner, Small, & Loewenstein, 2004) have demonstrated carryover effects of emotional states from one context into an unrelated one. In the case of carryover sadness emotional experiences, the priming effect is strong enough to reverse the usual endowment effect (Kahneman, Knetsch, & Thaler, 1991) on one's valuation of a commodity (Lerner et al., 2004). In both the Zillman and the Lerner research paradigms, the arousal or emotion experienced earlier in the experimental session continues to influence the participant but without his or her awareness of that continuing influence; many minutes later, this influence is demonstrated, compared to control conditions, on the second task.

Given the historical precedence and the many and varied demonstrations of carryover priming effects in the psychological literature, there is no logical reason for invoking the Meyer-Schvaneveldt type of priming, and its short duration, as a kind of litmus test for the plausibility of other forms of priming effects. There is also no logical basis in historical precedence or the overall research evidence base to restrict plausible priming effects to perceptual interpretation or to be skeptical that priming could influence higher-order cognition; the latter has been demonstrated many times in many areas of psychological research in addition to social-behavioral priming.

IMITATION AND MIMICRY: THE PERCEPTION-BEHAVIOR LINK

There is a second historical basis for behavioral priming effects in social psychology. Historically, social as well as developmental psychology have long focused on how the perceived behavior of others influences one's own behavioral tendencies. The study of *imitation and mimicry* tendencies (starting with the early Gestalt

psychologists Koffka and Koehler in the 1920s) documented how social perceptual activity naturally creates tendencies to physically behave in the same manner, in young children as well as adults. This “perception-behavior link” (Chartrand & Bargh, 1999) exists in humans as in many other animals (e.g., birds, fish, antelope; see review in Dijksterhuis & Bargh, 2001). Moreover, the fact that perceiving another’s behavior automatically activates tendencies to behave similarly oneself is in harmony with long-standing social psychological research that focuses on conformity and group coordination, and behavioral and emotional contagion effects, as well as imitation and mimicry.

Imitation and mimicry based on the perceived physical behavior of another person is present starting in infancy and toddlerhood and has been amply demonstrated in imitation and behavioral mimicry tendencies in adult humans (see Chartrand & Lakin, 2013 for a review; Chartrand & Bargh, 1999; Hatfield, Cacioppo, & Rapon, 1993; Kohler, 1925; Meltzoff, 1985; Meltzoff & Moore, 1977, 1983). Yet behavioral priming, which in its semantic form has engendered such skepticism and controversy recently, is the same phenomenon as imitation and mimicry, because whether the priming vehicle is semantic (e.g., action verbs) or the physical behavior of others, internal social-perceptual representations are activated that increase the probability of behaving the same way oneself (Chartrand, Maddux, & Lakin, 2005; Dijksterhuis & Bargh, 2001). Pointing out that these were the same basic phenomena, Chartrand and colleagues (2005) identified two sources of perception-behavior effect: *observables* and *abstract representations* and argued that both of these had their effect through the activation of related behavioral tendencies.

Social network studies (Christakis & Fowler, 2009) have shown how important forms of social behavior spread in a social network, typically to three degrees of separation or more between the individuals, so that the chain of our influence on others extends to many people we do not know and have never met. Obesity, cooperation, and others spread this way, as well as physical health problems such as diseases spread by germs. The perception-behavior link—the natural priming of behavioral tendencies by the perceived state or behavior of others—is very likely one important mechanism by which this spread occurs, unless one wants to insist—against the dictates of Occam’s razor—that in each node of the network the individual is consciously thinking and deciding to behave the same way as the person they are interacting with. On that point, we already know from the chameleon effect (Chartrand & Bargh, 1999) and extensive subsequent imitation and mimicry research (reviewed in Chartrand & Lakin, 2013) that this additional conscious decision step is not necessary for behavioral contagion effects to occur.

Prinz’s (e.g., 1997) notion of a representational overlap between perception and behavior was the forerunner of neuroscience research on “mirror neurons.” Rizzolatti and colleagues (e.g., Rizzolatti & Sinigaglia, 2008) revealed shared regions of activation (in premotor cortex) when primates (including humans) observed another’s action compared to when they performed the action themselves. Moreover, validating the equivalency of semantic and direct-perceptual vehicles for behavioral priming effects as argued by Chartrand and colleagues (2005), several of the mirror-neuron studies revealed effects of semantic priming on behavioral dispositions. Perani and colleagues (1999) showed that merely hearing action verbs activates implicit motor representations, as well as working memory structures

such as the dorsolateral prefrontal cortex, the anterior cingulate, and premotor and parietal cortices, all of which are needed to carry out that behavior in an uncertain environment. Jeannerod (1999) showed that this link works in the other direction as well: observation of a meaningful action caused the activation of the same brain area (Brodmann 45) as did the generation of action verbs by the participant, or his or her active retrieval of verbs from memory. Grezes and Decety (2001, p. 12) concluded from a review of the verb-motor program research that, "motor programs can be seen as part of the meaning of verbal items that represent action."

Although words standing for these types of behavior have been used in laboratory studies as symbolic equivalents (and it is these original demonstrations involving verbal stimuli that have tended to be the focus of the recent replication attempts), the underlying and natural priming mechanism is the social perception of others' behavior. In line with this assumption, as noted in the previous section, factors that enhance or attenuate social-behavior priming effects, such as our liking versus disliking for the stereotyped group that is primed are also moderators of whether we will imitate the physical behavior of others (see Chartrand & Lakin, 2013, for a review).

Smith and Mackie (2014) similarly argue that the degree of self-other overlap will be an important moderator of interpersonal priming effects. As they point out, the cognitive psychology account of the function of priming as for perceptual anticipations only is "overly individualistic." Another function of priming "is social coordination, enabling convergence of beliefs, attitudes, emotions, and behavior within a dyadic relationship or ingroup." Smith and Mackie have extended the sources of these interpersonal priming effects to include one's simulations of others' likely responses in a given situation, based on that other person's presumed beliefs, attitudes, emotions or behavior.

Other articles in this special issue (Loersch & Payne, 2014; Wheeler, DeMarree, & Petty, 2014) also argue that an important moderator of the perception-behavior effect is the inclusion of the primed content into the active self-concept. Indeed, in the first published set of studies replicating the elderly-walking effect (Bargh, Chen, & Burrows, 1996), Hull, Slone, Meteyer, and Matthews (2002) published five studies in which stereotypes, emotional faces, and achievement-related primes were presented either subliminally or supraliminally. In two studies, implicit elderly-stereotype primes caused participants subsequently to walk more slowly, replicating the original effect, but only for dispositionally high self-conscious individuals.

That the primed trait construct needs to be included in the active self-concept for behavioral priming to occur is also consistent with research on "stereotype threat" effects (Steele & Aronson, 1995) in which the trait construct is *chronically* part of the person's identity already, as the group membership (to which the stereotype applies) is part of that person's self-concept. For example, Ambady, Shih, Kim, and Pittinsky (2001) showed stereotype threat on math task performance in girls as young as 5 years. In line with the stereotype contents, their task performance was better if the Asian identity had been primed but worse, compared to a control condition, if the female identity had been primed; the primes were drawings of children with Asian features or of non-Asian female children.

PRIMING EFFECTS IN REAL-WORLD CONTEXTS

As evidenced by the behavioral priming effects demonstrated by Ambady and colleagues (2001) in 5-year-old children (see Over & Carpenter, 2009, for similar behavior priming effects in 18-month-old infants), social priming effects likely reflect the operation of a natural, evolved mechanism. Therefore, they should be more likely to occur the more that the priming stimuli resemble the natural kinds corresponding to evolved adaptations. As argued above, for social behavioral priming the main natural prime is the behavior of other people (Chartrand & Bargh, 1999), including nonverbal emotional expressions and body posture. Another type of naturalistic prime is using real-life situational contexts as primes instead of verbal material, such as actual television shows containing actual food advertising (Harris, Bargh, & Brownell, 2009), or sitting in the professor's versus the student's office chair in order to fill out some questionnaires (to prime power: Chen, Lee-Chai, & Bargh, 2001). While verbal stimuli have often been used as convenient priming vehicles, the focus of the research was never on words per se or the effects they can produce but on generalizing the priming effect to natural real world contexts.

Real-life contexts are more natural, complete, and richer sources of primes than the artificial and simple lab environments required to demonstrate and disentangle them. Recent field studies have in fact confirmed the real world importance and influence of priming effects for important *in vivo* social behaviors, such as following norms (versus antisocial behavior) and voting in actual elections as well as the impulsivity of financial decision making.

1. Berger, Meredith, and Wheeler (2008) studied patterns of actual voting behavior for ballot referenda and showed that the situational context in which votes were cast influenced the outcome of the election within the same election district (town, region of the country): If the precinct's polling location was in a church, religion-related issues on the ballot received more votes than otherwise; if the location was in a school, education-related issues (e.g., school bond referenda) received more votes compared to other polling locations in the same locality.
2. In a set of field experiments, Keizer, Lindenberg, and Steg (2008) showed that people were more likely to behave in unscrupulous ways, such as littering, stealing, or disobeying posted signs, in contexts where there was evidence of past disorder (e.g., graffiti, litter). Behavior priming thus has real social consequences and can occur even in the absence of the original actors and the actual behavior being mimicked—when only vestiges of the relevant behavior remain. Simply perceiving evidence that social norm violations have been committed in the recent past—such as when viewing graffiti scrawled on city walls or litter on the streets—leads to the general spreading of disorder and crime.
3. Papies and colleagues (2013) conducted a field experiment in which overweight and obese customers in a grocery store were handed either a recipe flier containing healthy and diet-related primes or a control flier. Then, at checkout, those in the healthy/diet prime condition were found to have purchased nearly 75% fewer snacks at the store than did those in the control condition. When participants were debriefed after leaving the store, information on their purchases was obtained from their receipts. Questions were also asked about how much they had thought about the recipe flyer during shopping, and no effects of amount of thought about the flyer on purchasing were found; the authors concluded that

“the effects of the health prime on purchasing behavior were independent of whether participants consciously thought about it during shopping.” Moreover, only a tiny minority of the participants could recall whether the recipe was either low in calories or contained diet-related words, and none of the participants showed awareness of the hypothesis of the study.

Of course, in any field study it is difficult to control for factors that can be controlled much better in laboratory settings. Thus, it is important to note that in their prior laboratory studies in which such control was possible, Papies and colleagues showed similar unconscious operation of the weight control goal using subliminal priming methods. For example, dieters who were primed subliminally with their weight control goal paid reduced attention to hedonic food cues compared with dieters who had not been primed (Papies, Stroebe, & Aarts, 2008).

4. DeVoe, House, and Zhong (2013) in a correlational study showed that the number of fast food restaurants located in an online study participant's zip code region predicted the speed and impulsivity with which the participant made financial decisions. The more fast food restaurants in the participants' natural ecology (very visible on the streets and roads), the faster and more impulsive were his or her financial decisions across several studies. Households saved less when living in neighborhoods with a higher concentration of fast food restaurants relative to full service restaurants. On a direct measure of individuals' delay discounting preferences, a higher concentration of fast food restaurants within one's neighborhood was associated with greater financial impatience. In an experimental test, having participants recall a recent fast food, as opposed to full service, dining experience at restaurants within the same neighborhood induced greater delay discounting tendencies (financial impatience). Finally, pedestrians walking down the same city street manifested greater delay discounting in their choices of financial reward if they were surveyed in front of a fast food restaurant, compared to a full service restaurant. The researchers concluded that the pervasiveness of organizational cues in the everyday social ecology can have a far-ranging influence on an individual's important decisions and behaviors.
5. Zaval, Keenan, Johnson, and Weber (in press) showed how contextual effects of the current general ambient temperature (i.e., hot weather vs. cold weather over a period of time) strongly influence the public's concern over the global warming or climate change problem. In general, when the current weather is hot, public opinion holds that global warming is occurring, and when the current weather is cold, people believe less that global warming is a general problem. This contextual influence on belief in a long-term problem is akin to Schwarz and Clore's (1983) demonstration that the current weather (sunny vs. cloudy) influenced the survey respondents' opinions about their overall life satisfaction.

In one of a series of studies to get at the underlying reasons why current weather influenced opinions about long-term climate change patterns, Zaval and colleagues used scrambled sentence priming of heat, cold, or neutral related topic sentences to show that it is the accessibility of similar (to the current day's weather) hot or cold days in memory that produced the effect on global warming opinions (i.e., the availability heuristic in operation). Those primed with heat-related concepts were more concerned about global warming as a problem than were other participants, and in further studies, those who believed the current weather was unusually hot also believed that more days over the past year had been hotter than average, compared to the estimate of other participants.

Because public opinion strongly shapes public policy on climate change, this natural weather-priming effect has high practical importance.

6. Just as the perceived behavior of others is the natural behavioral prime, the perceived goal of others is a natural prime for one's own unconsciously instigated goal pursuits. Thus, Aarts, Gollwitzer, and Hassin (2004) showed *goal-contagion* effects such that the perceived goal pursuits of another person caused the perceiver to be more likely to pursue that same goal. Friedman and colleagues (2010) also showed that motivational orientations could be primed with observations of others' behavior, creating what they called "motivational synchrony" between the interactants. Moreover, Hamlin, Hallinan, and Woodward (2008) demonstrated these same types of goal-contagion effects in infants as young as 7 months.

Consistent with the present hypothesis that more realistic stimuli produce more reliable priming effects, Latham and colleagues, in a series of studies, used a photographic high-performance manipulation to consistently produce higher workplace task performance. Using a photograph of a woman winning a long-distance road race, the researchers successfully primed achievement motivation, as classically assessed by free responses on the projective Thematic Apperception Test (TAT). Then, Shantz and Latham (2009) found that working adults who were primed by that same photograph wrote significantly more ideas for a brainstorming task than people who had been given a blank sheet of paper, and in a subsequent field study (Shantz & Latham, 2011), the presence of that prime resulted in significantly higher amounts of money solicited for charities by telephone call center employees. This result was replicated in two additional call centers, and the TAT and call center fundraising results were again replicated in additional studies by Latham and Piccolo (2012), who showed further that the increase in fund-raising held across the entire subsequent work week.

7. One large class of motivational behavioral priming effects are automatic approach or avoidance arm and hand (finger) movement tendencies in response to positive versus negative stimuli, respectively (Cacioppo, Priester, & Berntson, 1993; Chen & Bargh, 1999). Although space limitations preclude a more complete review of the replications of this effect, as with the behavior and goal priming domains discussed above, the original Chen and Bargh research has been a) both exactly and conceptually replicated, b) extended by further discovery of important contextual moderating variables, and c) shown to have important practical consequences and applications. Its ecological validity was demonstrated by Slepian and colleagues (2012) who found that participants were faster to make approach movements to trustworthy faces and avoidance movements to untrustworthy faces, even though their task was merely to classify face versus house pictures and no explicit evaluation instructions were given. Its practical importance was shown by its success as a means to reduce alcohol cravings and reverse positive implicit attitudes toward alcohol to negative attitudes in a series of studies by Wiers and colleagues (2010, 2011). Compared to a control group, participants trained to make implicit avoidance movements (push) to alcohol-related and control stimuli, merely by classifying the presented photos as either landscape or portrait orientation, had their automatic positive attitudes toward alcohol change to negative, and were found a year later to have substantially lower drinking relapse rates (59 to 46%).

EMERGING fMRI STUDIES OF SOCIAL PRIMING EFFECTS

Before closing, it is important to note that an emerging research literature involving fMRI brain region imaging during priming manipulations is both replicating the original social behavioral and judgmental priming effects and revealing further details as to the brain regions involved in producing them. Brain imaging of priming effects furnishes a more sensitive form of measurement of the effects of primes on mental processes, compared to collection of the behavioral dependent variable alone, as the latter is subject to considerable variability from many other simultaneous influences. Space constraints do not permit a full description and review of these new studies, but here are a few examples.

1. Inagaki and Eisenberger (in press), using fMRI methods, compared brain regions activated while the participant read socially warm as well as socially neutral messages from close others, on the one hand, to those brain regions activated when the participant held physically warm as well as neutral temperature objects. Replicating previous research (e.g., Williams & Bargh, 2008), Inagaki and Eisenberger observed an overlap in subjective experience following manipulations of social versus physical warmth: participants felt physically warmer after reading the socially warm messages (compared to the neutral messages), and they also felt more connected to their close others after holding the physically warm stimulus (compared to the neutral temperature stimulus). They also found that neural activity during social warmth overlapped with neural activity during physical warmth in the ventral striatum and middle insula, but neural activity did not overlap during a control task (soft touch). The authors concluded that “together, these results suggest that a common neural mechanism underlies physical and social warmth.”
2. Schaefer, Heinze, and Rotte (in press), in a within-participant design, replicated the behavioral priming findings of Ackerman, Nocera, and Bargh (2010), with rough physical primes causing social judgments that social interactions were less smooth and coordinated (across 96 different interaction scenarios). Simultaneous fMRI imaging revealed a significant involvement of the somatosensory cortex in making the coordination but not the control relationship-quality judgments. Using a within-participant design, each participant received a smooth versus a rough versus no physical prime before reading each given scenario. Significant correlations were obtained between primary somatosensory cortex activation and the extremity of not-smooth (rough) judgments of interaction coordination. Thus, physical primes influence more abstract social judgments through the involvement of sensory brain regions at the time of judgment.
3. Bengtsson, Dolan, and Passingham (2011) in an fMRI study primed participants to “be clever” or to “be stupid” (in a replication of Dijksterhuis & van Knippenberg, 1998) and assessed the priming’s effect on the *n*-back task. Activating the representation of “clever” caused participants to slow their reaction times after errors on the working memory task, while the reverse pattern was seen for participants primed with “stupid.” Critically, these behavioral effects were absent in control conditions. The fMRI data showed that the neural basis of this effect involves the anterior paracingulate cortex (area 32) where activity tracked the observed behavioral pattern, increasing its activity during error monitoring in

the “clever” condition and decreasing in the “stupid” condition. The researchers concluded that implicit cues, which specifically target a person’s self-concept, influence the way people react to their own behavior, in harmony with the emerging conclusion of how behavioral priming effects operate via involvement of the self-concept (see above).

CONCLUSIONS

Here, I have argued that it is both misleading and historically inaccurate to use the Meyer and Schvaneveldt (M-S; 1971) semantic priming paradigm as a standard against which to assess the plausibility of social and behavioral priming effects. The short time course of the M-S form of priming is likely because of the very short duration of the priming stimulus and the minimal deliberative processing given that prime in the lexical decision task (indeed participants are instructed not to respond to the prime stimulus at all and only to the target stimulus that follows on each trial). The actual origins of the priming concept and of priming research itself are instead much more in harmony with the social psychological tradition of priming studies. Lashley (1951) originated the concept as a theoretical vehicle to approach the problem of response or behavior preparation, especially in speech production. Thus, the concept of priming originated as a proposed mechanism for the activation of behavioral tendencies. Research after Lashley (1951), but well before the M-S studies, used the same “carryover effect” or “unrelated studies” paradigm that first Higgins and colleagues (1977) and then most other social judgment and behavior priming effects emulated. In those carryover priming studies, effects lasted many minutes, not merely the brief milliseconds duration of the M-S studies. Thus, the M-S paradigm should not be used as a litmus test for the plausibility of other priming studies, either for the nature of their effects on behavior and higher-order forms of cognition (as compared to perceptual interpretation) or for the duration of their priming effects.

The duration of a priming effect appears to be a function of the extent of the deliberate or effortful processing of the priming stimuli as required by the priming task. Clearly, the semantic priming stimulus in the M-S type of priming is very fleeting and short lived, and participants are not attending to it but rather to the target stimulus that comes next. When a greater degree of processing of the priming stimuli is required, priming effects last longer. And when physiological arousal-based priming occurs, as in excitation transfer and emotional priming carryover effects, the effect can last even longer (see Srull & Wyer, 1980, for an experimental demonstration).

Second, semantic behavioral priming effects are of the same class of phenomena as imitation and mimicry effects (perception-behavior effects), which are established beyond doubt. If one chooses not to believe in the reality of behavioral priming, then they also do not believe in the reality of imitation and mimicry effects. If skeptics of behavioral priming studies do not wish to include imitation and mimicry effects as examples of behavioral priming, then they should explicitly restrict their skepticism to semantic priming effects (or those that do not involve the physical behavior of others or natural contexts and carryover effects, as in arousal and emotional priming), not of behavioral priming per se (in which the most common naturally occurring prime is the behavior of other people). Unlike

cognitive psychology, social psychology's history has focused on behavioral contagion, conformity, and imitation effects and is not as concerned with the effects of more artificial verbal and symbolic stimuli as is cognitive psychology. Social psychology has instead striven to use more naturally occurring stimuli as primes that then produce behavioral tendencies as well as influences on social judgments and other higher mental processes. This is because our goal has been to establish the ecological validity of our procedures and to be able to generalize to real-world stimuli and situations.

Thus, it is of high importance that studies of social priming effects have successfully demonstrated real-life priming effects. Whether or not every researcher can successfully reproduce the behavioral priming effects in the laboratory, these effects are being demonstrated to have real-world impact and importance, such as in the spread of social disorder, contextual effects of the polling place on election outcomes, and job performance in actual workplaces. The behavior priming effects first demonstrated in the laboratory are now being successfully translated into effective real-world applications, such as decreasing the purchase of unhealthy snacks in grocery stores by overweight individuals, increasing the amount of money raised for charities, and therapeutic interventions that significantly reduce cravings and relapse rates among addicts. These successful practical uses of behavioral priming effects to reduce the suffering and improve the lives of real individuals would not be possible unless the effects were real in the first place, as well as robust enough for practical application.

REFERENCES

- Aarts, H., Gollwitzer, P. M., & Hassin, R. R. (2004). Goal contagion: Perceiving is for pursuing. *Journal of Personality and Social Psychology, 87*, 23-37.
- Ackerman, J. M., Nocera, C. C., & Bargh, J. A. (2010, 25 June). Incidental haptic sensations influence social judgments and decisions. *Science, 328*, 1712-1715.
- Ambady, N., Shih, M., Kim, A., & Pittinsky, T. L. (2001). Stereotype susceptibility in children: Effects of identity activation on quantitative performance. *Psychological Science, 12*, 385-390.
- Bargh, J. A. (1989). Conditional automaticity: Varieties of automatic influence in social perception and cognition. In J. S. Uleman & J. A. Bargh (Eds.), *Unintended thought* (pp. 3-51). New York: Guilford.
- Bargh, J. A., Chen, M., & Burrows, L. (1996). Automaticity of social behavior: Direct effects of trait construct and stereotype priming on action. *Journal of Personality and Social Psychology, 71*, 230-244.
- Bengtsson, S. L., Dolan, R. J., & Passingham, R. E. (2011). Priming for self-esteem influences the monitoring of one's own performance. *Social Cognitive and Affective Neuroscience, 6*, 417-425.
- Berger, J., Meredith, M., & Wheeler, S. C. (2008). Contextual priming: The influence of polling location type on voting behavior. *Proceedings of the National Academy of Sciences, 105*, 8846-8849.
- Bruner, J. S. (1957). On perceptual readiness. *Psychological Review, 64*, 123-152.
- Cacioppo, J. T., Priester, J. R., & Berntson, G. G. (1993). Rudimentary determinants of attitudes. II: Arm flexion and extension have differential effects on attitudes. *Journal of Personality and Social Psychology, 65*, 5-17.
- Chartrand, T. L. & Bargh, J. A. (1999) The chameleon effect: The perception-behavior link and social interaction. *Journal of Personality and Social Psychology, 76*, 893-910.

- Chartrand, T. L. & Lakin, J. (2013). The antecedents and consequences of human behavioral mimicry. *Annual Review of Psychology*, 64, 285-308.
- Chartrand, T. L., Maddux, W. W., & Lakin, J. L. (2005). Beyond the perception-behavior link: The ubiquitous utility and motivational moderators of nonconscious mimicry. In R. R. Hassin, J. S. Uleman, & J. A. Bargh (Eds.), *The new unconscious* (pp. 334-361). New York: Oxford University Press.
- Chen, M., & Bargh, J. A. (1999). Consequences of automatic evaluation: Immediate behavioral predispositions to approach or avoid the stimulus. *Personality and Social Psychology Bulletin*, 25, 215-224.
- Chen, S., Lee-Chai, A. Y., & Bargh, J. A. (2001). Relationship orientation as a moderator of the effects of social power. *Journal of Personality and Social Psychology*, 80, 173-187.
- Christakis, N. A., & Fowler, J. H. (2009). *Connected: The surprising power of our social networks and how they shape our lives*. New York: Little Brown.
- Clark, A. (1998). *Being there: Putting brain, body, and world together again*. Cambridge, MA: MIT Press.
- DeVoe, S. E., House, J., & Zhong, C. (2013) Fast food and financial impatience: A socio-ecological approach. *Journal of Personality and Social Psychology*, 105, 476-494.
- Dijksterhuis, A., & Bargh, J. A. (2001). The perception-behavior expressway: Automatic effects of social perception on social behavior. *Advances in Experimental Social Psychology*, 33, 1-40.
- Dijksterhuis, A., & van Knippenberg, A. (1998). The relation between perception and behavior, or how to win a game of Trivial Pursuit. *Journal of Personality and Social Psychology*, 74, 865-877.
- Engel, A. K., Mare, A., Kurthen, M., & Koenig, P. (2013). Where's the action? The pragmatic turn in cognitive science. *Trends in Cognitive Science*, 17, 8-15.
- Friedman, R., Deci, E. L., Elliot, A., Moller, A., & Aarts, H. (2010). Motivation synchronicity: Priming motivational orientations with observations of others' behavior. *Motivation and Emotion*, 34, 34-38.
- Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.
- Grand, S., & Segal, S. J. (1966). Recovery in the absence of recall. *Journal of Experimental Psychology*, 72, 138-144.
- Grezes, I., & Decety, J. (2001). Functional anatomy of execution, mental simulation, observation, and verb generation of actions: A meta-analysis. *Human Brain Mapping*, 12, 1-19.
- Hamlin, J. K., Hallinan, E. V., & Woodward, A. L. (2008). Do as I do: 7-month-old infants selectively reproduce others' goals. *Developmental Science*, 11, 487-494.
- Harris, C. R., Coburn, N., Rohrer, D., & Pashler, H. (2013). High-performance-goal priming? Two failures to replicate. *PLOS ONE*, 8(8), e72467.
- Harris, J. L., Bargh, J. A., & Brownell, K. D. (2009). Priming effects of television food advertising on eating behavior. *Health Psychology*, 28, 404-413.
- Hatfield, E., Cacioppo, J. T., & Rapson, R. L. (1993). Emotional contagion. *Current Directions in Psychological Science*, 2, 96-100.
- Higgins, E. T., Rholes, W. S., & Jones, C. R. (1977). Category accessibility and impression formation. *Journal of Experimental Social Psychology*, 13, 141-154.
- Hull, J. G., Slone, L. B., Meteyer, K. B., & Matthews, A. R. (2002). The nonconsciousness of self-consciousness. *Journal of Personality and Social Psychology*, 83, 406-424.
- Inagaki, T. K., & Eisenberger, N. I. (in press). Shared neural mechanisms underlying social warmth and physical warmth. *Psychological Science*. doi:10.1177/0956797613492773
- Jeannerod, M. (1999). To act or not to act: Perspectives on the representation of actions. *Quarterly Journal of Experimental Psychology*, 52A, 1-29.
- Jones, E. E., & Nisbett, R. E. (1971). The actor and the observer: Divergent perceptions of the causes of behavior. In E. E. Jones, D. E. Kanouse, H. H. Kelly, R. E. Nisbett, S. Valins, & B. Weiner (Eds.), *Attribution: Perceiving the causes of behavior*. New York: General Learning Press.
- Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies: The endowment effect, loss aversion, and status quo bias. *Journal of Economic Perspectives*, 5, 193-206.

- Keizer, K., Lindenberg, S., & Steg, L. (2008, 12 December). The spreading of disorder. *Science*, 322, 1681-1685.
- Klatzky, R. L., & Creswell, J. D. (in press). An inter-sensory interaction account of priming effects – and their absence. *Perspectives on Psychological Science*.
- Knuf, L., Aschersleben, G., & Prinz, W. (2001). An analysis of ideomotor action. *Journal of Experimental Psychology: General*, 130, 779-798.
- Koestler, A. (1967). *The ghost in the machine*. New York: Macmillan.
- Kohler, W. (1925). *The mentality of apes*. New York: Harcourt, Brace & Co.
- Koriat, A., & Feuerstein, N. (1976). The recovery of incidentally acquired information. *Acta Psychologica*, 40, 463-464.
- Lashley, K. S. (1951). The problem of serial order in behavior. In L. A. Jeffress (Ed.), *Cerebral mechanisms in behavior* (pp. 112-131). New York: Wiley.
- Latham, G. P., & Piccolo, R. F. (2012). The effect of context specific versus nonspecific subconscious goals on employee performance. *Human Resources Management*, 51, 535-548.
- Lerner, J. S., & Keltner, D. (2001). Fear, anger, and risk. *Journal of Personality and Social Psychology*, 81, 146-159.
- Lerner, J. S., Small, D. A., & Loewenstein, G. (2004). Heart strings and purse strings: Carryover effects of emotions on economic decisions. *Psychological Science*, 15, 337-341.
- McArthur, L. Z., & Baron, R. S. (1983). Toward an ecological theory of social perception. *Psychological Review*, 90, 215-238.
- Meltzoff, A. N. (1985). Immediate and deferred imitation in fourteen- and twenty-month-old infants. *Child Development*, 56, 62-72.
- Meltzoff, A. N., & Moore, M. K. (1977). Imitation of facial and manual gestures by human neonates. *Science*, 198, 75-78.
- Meltzoff, A. N., & Moore, M. K. (1983). New-born infants imitate adult facial gestures. *Child Development*, 54, 702-709.
- Meyer, D. E., & Schvaneveldt, R. W. (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology*, 90, 227-234.
- Morsella, E., Bargh, J., & Gollwitzer, P. (Eds., 2009). *Oxford handbook of human action*. New York: Oxford University Press.
- Neisser, U. (1967). *Cognitive psychology*. New York: Appleton-Century-Crofts.
- Norretranders, T. (1998). *The user illusion*. New York: Viking.
- Over, H., & Carpenter, M. (2009). Eighteen-month-old infants show increased helping following priming with affiliation. *Psychological Science*, 20, 1189-1193.
- Papies, E. K., Potjes, I., Keesman, M., Schwinghammer, S., & van Koningsbruggen, G. M. (2013). Using health primes to reduce unhealthy snack purchases among overweight consumers in a grocery store. *International Journal of Obesity*, 1-6.
- Papies E. K., Stroebe, W., & Aarts, H. (2008). The allure of forbidden food: On the role of attention in self-regulation. *Journal of Experimental Social Psychology*, 44, 1283-1292.
- Perani, D., Cappa, S. F., Schnur, T., Tettamanti, M., Collina, S., Rosa, M. M., & Fazio, F. (1999). The neural correlates of verb and noun processing: A PET study. *Brain*, 122, 2337-2344.
- Prinz, W. (1997). Perception and action planning. *European Journal of Cognitive Psychology*, 9, 129-154.
- Rizzolatti, G., & Sinigaglia, C. (2008). *Mirrors in the brain: How our minds share actions and emotions*. New York: Oxford University Press.
- Schacter, D. L. (1987). Implicit memory: History and current status. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 13, 501-518.
- Schaefer, M., Heinze, H.-J., & Rotte, M. (in press). Rough primes and rough conversations: Evidence for a modality-specific basis to mental metaphors. *Social Cognitive and Affective Neuroscience*.
- Schwarz, N., & Clore, G. L. (1983). Mood, misattribution, and judgments of well-being: Informative and directive functions of affective states. *Journal of Personality and Social Psychology*, 45, 513-523.
- Segal, S. J. (1967). The priming of association test responses. *Journal of Verbal Learning and Verbal Behavior*, 6, 216-221.
- Segal, S. J., & Cofer, C. N. (1960). The effect of recency and recall on word association. *American Psychologist*, 15, 451.

- Shantz, A., & Latham, G. P. (2009). An exploratory field experiment of the effect of subconscious and conscious goals on employee performance. *Organizational Behavior and Human Decision Processes*, 109, 9-17.
- Shantz, A., & Latham, G. P. (2011). The effect of primed goals on employee performance: Implications for human resource management. *Human Resource Management*, 50, 1-11.
- Slepian, M. L., Young, S. G., Rule, N. O., Weisbuch, M., & Ambady, N. (2012). Embodied impression formation: Social judgments and motor cues to approach and avoidance. *Social Cognition*, 30, 232-240.
- Smith, E. R., & Mackie, D. M. (2014). Taking priming interpersonal: Priming from other's observed or simulated responses. *Social Cognition*, 32, 184-195.
- Srull, T. K., & Wyer, R. S., Jr. (1980). The role of category accessibility in the interpretation of information about persons: Some determinants and implications. *Journal of Personality and Social Psychology*, 37, 1660-1667.
- Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology*, 69, 797-811.
- Storms, L. H. (1958). Apparent backward association: A situational effect. *Journal of Experimental Psychology*, 55, 390-395.
- Wiers, R. W., Rinck, M., Kordts, R., Houben, K., & Strack, F. (2010). Retraining automatic action-tendencies to approach alcohol in hazardous drinkers. *Addiction*, 105, 279-287.
- Wiers, R. W., Eberl, C., Rinck, M., Becker, E. S., & Lindenmeyer, J. (2011). Re-training automatic action tendencies changes alcoholic patients' approach bias for alcohol and improves treatment outcome. *Psychological Science*, 22, 490-497.
- Williams, L. E., & Bargh, J. A. (2008, 24 October). Experiencing physical warmth influences interpersonal warmth. *Science*, 322, 606-607.
- Zaval, L., Keenan, E. A., Johnson, E. J., & Weber, E. U. (in press). How warm days increase belief in global warming. *Nature: Climate Change*. doi:10.1038/nclimate2093
- Zillman, D. (1978). Attribution and misattribution of excitatory reactions. In J. H. Harvey, W. J. Ickes, & R. F. Kidd (Eds.), *New directions in attribution research* (Vol. 2, pp. 335-368). Hillsdale, NJ: Erlbaum.

Copyright of Social Cognition is the property of Guilford Publications Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.