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THE PERVERSITY OF INANIMATE OBJECTS: STIMULUS CONTROL BY INCIDENTAL MUSICAL NOTATION

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Social cognition research suggests that incidental, environmental stimuli (e.g., business suits) can nonconsciously influence the degree to which behavioral dispositions (e.g., competitiveness) are expressed. Similarly, cognitive research suggests that incidental action–related objects (e.g., hammers) can prime action plans that then affect the speed with which a concurrent, intended action (e.g., power grip) is executed. However, whether incidental stimuli can instigate actions that run counter to one's current goals has yet to be determined. Moving beyond indirect effects, we show that such stimuli can directly cause the expression of undesired actions: Incidental stimuli resembling musical notation caused the systematic expression of unintended key presses in musicians, but not in nonmusicians. Moreover, the effect was found even when targets and distracters bore no apparent perceptual or semantic relation. We discuss the implications of these findings for models of action production and for social–cognitive concepts (e.g., applicability) regarding the limits of nonconscious processing.

Can the objects that once held "stimulus control" over us (e.g., tools or musical notation) re–exert their influence against our will in a novel context? For example, when flicking a switch in a tool shed with one hand, can the move-

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ments of the other, "idle" hand be influenced by the mere presence of the tools comprising the visual scene? Although these questions have never been addressed empirically, convergent findings from social psychology, cognition, and neuropsychology (see reviews in Dijksterhuis & Bargh, 2001; Logan, 2005; Frith, Blakemore, & Wolpert, 2000; respectively) suggest that the answer is yes. Contrary to what our subjective experience leads us to believe, many of our behaviors occur automatically, determined by causes far removed from our awareness (e.g., covert priming). It has been demonstrated that people automatically imitate the postures, facial expressions, and speaking styles of others (Chartrand & Bargh, 1999; Giles, Coupland, & Coupland, 1991) and that behavioral patterns can be activated by incidental stimuli. For example, when primed with the stereotype of "elderly," people walk slower (Bargh, Chen, & Burrows, 1996); when primed with "library," they make less noise (Aarts & Dijksterhuis, 2003); when primed with "hostility," they become more aggressive (Carver, Ganellen, Froming, & Chambers, 1983); and when presented with business–related objects, they become more competitive (Kay, Wheeler, Bargh, & Ross, 2004). Together, these findings suggest that there is an automatic *perception–behavior link* from perceptual processing to some form of action planning (Dijksterhuis & Bargh, 2001).

Yet, despite mounting evidence, little is known about the mechanisms underlying the perception–behavior link and whether they can spur certain kinds of behaviors into expression. Primes (e.g., *hammer, elderly,* or *library*) have been shown to piggyback upon and influence actions that were already intended (e.g., to grasp, walk, or speak, respectively), but can they lead to the kinds of unintentional actions mentioned in our questions above? To shed light on these issues, we propose a *cascade model* (McClelland, 1979) to understand perception–behavior effects.[1]

Cascade models suggest that semantic activation arising from perceiving a social or non–social object automatically leads to the activation of the action plans associated with that object, suggesting, for example, that merely perceiving an object can activate the phonological representations that are normally used to name that object. Specifically, they propose that activation can flow from semantic levels onto phonological levels of representation without word selection having taken place. *Serial models*, on the other hand, propose that only the word selected to be produced can activate phonology (Butterworth, 1992; Levelt, Roelofs, & Meyer, 1999).

Cascade models were evaluated by testing whether incidental objects influence phonological processing in a picture–picture interference paradigm.

1. The notion of cascade processing was introduced by McClelland (1979) to illuminate how information may flow from one stage of processing to the next in cognitive tasks such as identifying a printed word (cf., the notion of *continuous flow*; Eriksen & Schultz, 1979). Later, these models were applied to the study of speech production (e.g., Dell, 1986).

Speakers were shown pairs of superimposed pictures and were instructed to name one picture (the target) and ignore the other (the distracter). Consistent with cascade models but not serial models, naming was faster when target pictures were paired with phonologically–related (e.g., bed with bell) than with unrelated (e.g., bed with pin) distracters (Morsella & Miozzo, 2002; Navarrete & Costa, 2004), suggesting that, though not selected for production, distracter names were processed to some extent. (See Goldrick & Blumstein, 2006, for evidence that activation can cascade even onto articulatory processes.)

From this standpoint, upon presentation of a stimulus scene, the action plans associated with incidental stimuli become nonconsciously activated, but only one of them is selected for production (in the vernacular of psycholinguistics). Accordingly, regarding nonlinguistic acts, findings suggest that incidental stimuli (e.g., hammers) can automatically set us to physically interact with the world (e.g., to perform a power grip; Chen & Bargh, 1999; Tucker & Ellis, 2001, 2004; see neuroimaging evidence in Grézes & Decety, 2002; Longcamp, Anton, Roth, & Velay, 2005; Pulvermuller, 2005), and psychophysiological research shows that, in response–interference tasks, competition involves simultaneous activation of the brain areas associated with the target– *and* distracter–related responses (DeSoto, Fabiani, Geary, & Gratton, 2001).

Other evidence stems from variants of the Stroop paradigm (Stroop, 1935). For example, Stewart, Walsh, and Frith (2004) instructed sight–reading musicians to execute short keypress sequences (novel, online fingerings) in response to a series of visual, non–musical stimuli (numbers), in which each stimulus referred to a target key. The numbers happened to be superimposed on musical notation, which participants were instructed to ignore. Sometimes the number–to–finger mapping was congruent in that the target number and distracter musical note referred to the same finger; other times the mapping was incongruent, with each stimulus referring to a different finger. It was found that the irrelevant musical notation influenced the speed at which sequences were executed: Compared to a baseline condition, response times (RTs) were shorter in the congruent condition and longer in the incongruent condition. Importantly, this effect occurred for musicians but not for nonmusician controls. (For related neuroimaging data, see Stewart et al., 2003.) Similar RT effects from incidental stimuli have been found in flanker paradigms (Starreveld, Theeuwes, & Mortier, 2004).

Such RT effects, demonstrating interference with other, ongoing actions, are importantly suggestive but offer only indirect support for the claim that incidental objects can actually elicit actions. More direct evidence would consist of showing that such stimuli produce undesired behaviors (i.e., actions that do not serve the goals of the task at hand). For example, does incidental musical notation directly cause the behavioral expression of nonconscious plans, as in the form of unintended movements in a hand that should be idle?

We addressed this question by evaluating whether incidental stimuli resembling musical notation lead to certain kinds of unintended actions in trained sight–reading musicians but not in controls (nonmusicians). Although both cascade and serial models could account for most priming effects[2] (e.g., how the concept *library* induces quiet speech; Aarts & Dijksterhuis, 2003), only cascade models could account for such unintended actions. As illustrated in Figure 1, serial models suggest that only activation stemming from a target object (or representation) that has been selected for action can influence action–planning; the flow of activation from distracters should not influence processing beyond the level of action selection. Only cascade models suggest that activation stemming from a stimulus (e.g., a distracter) that has not been selected for action can still influence action–planning and elicit a behavioral response. From this standpoint, activation flows blindly from one level of processing to the next regardless of whether processing (e.g., selection) at previous stages has been completed.

OVERVIEW

In a cued–response task, sight–readers and controls were trained to press specified keys on a computer keyboard when presented with certain visual cues (letters). After training, in a variation of the flanker paradigm (Eriksen & Eriksen, 1974; van Veen, Cohen, Botvinick, Stenger, & Carter, 2001), the cue was sometimes surrounded by stimuli that loosely resembled musical notation (music–related distracters). To diminish experimental demand and have distracters that are less incidental than those of previous paradigms (e.g., Stewart et al., 2004), we did not want participants to explicitly recognize the distracters as musical notation. At other times, the cue was surrounded by distracters unrelated to music (fillers). To avoid habituation and strategic effects, it is standard for the critical trials to be less than 20% of the total trials (as in Navarrete & Costa, 2004). Participants were instructed to disregard all distracters and respond only to the target in the center of the screen as quickly and as accurately as possible.

Our present interest, however, lies not in the psychology of sight–reading per se, but rather in the general nature of environmentally–driven automaticity, which happens to be showcased dramatically in this cultur-

2. Experimental demonstrations of environmentally-driven automaticity in social cognition were simply not intended to adjudicate among the various possible underlying process models. Without specifying *a priori* which objects are regarded as targets or as incidental distracters, and which plans are regarded as "selected" or as "unselected," it is difficult to determine *post hoc* whether a prime influenced behavior via serial or cascade processes.

ally–transmitted skill. With respect to automatic action, sight readers are an excellent population to study because sight–reading is presumably one of the most automatic of skills, and all forms of sight–reading—whether for guitar, piano, or trumpet—involve the activation of action plans. We evaluated whether, for sight–readers, these plans are activated blindly (i.e., regardless of context) by music–related stimuli. We presumed that, be they trained as guitarists, pianists, or flutists, musicians would be primed into an action–prone state when confronted with music–related stimuli; and that such a state would activate the kinds of plans that had been elicited by similar stimuli in the past. For musicians but not controls, such stimuli tend to be associated with plans that require use of both hands, as when a guitarist frets a note and plucks a string, or a pianist plays a melody over a chord.

It was expected that, faced with music–related distracters, all participants would exhibit a medley of error types, including anticipations, hesitations, and fingering errors. However, as only musicians are posited to possess previously acquired, distracter–relevant plans that involve both hands, it was predicted that, compared to controls, they would be more likely to make a kind of error in which a wrong key is pressed with the hand that, at that moment in time, should be idle (an "idle–hand" error). According to theory, only musicians should have both limbs activated when confronted with music–related distracters. Thus, in contrast to general errors (e.g., anticipations and hesitations) and errors made while using an incorrect finger of the correct hand ("correct–hand" errors), only idle–hand errors were predicted to differentiate musicians and nonmusicians on this task. Within this paradigm, idle–hand errors are dramatic and unequivocal proof of such activation having taken place. Importantly, it was predicted that musicians would display greater rates of this kind of error only in the presence of music–related (i.e., nonfiller) distracters. In this context, regardless of a musician's instrument or musical notation of choice (e.g., treble or bass clef), idle–hand errors serve as an informative primary dependent measure.

Previous research suggests that stimulus control effects occur only if targets and distracters are associated in some way. Effects have been obtained with distracters that are related to targets semantically (MacLeod, 1991), functionally (Eriksen & Shultz, 1979), or phonologically (Navarrete & Costa, 2004). Regarding functional relations, the mere presence of a hammer may influence the way a bottle is grasped (Tucker & Ellis, 2001, 2004). However, in natural scenes, seldom are targets (e.g., a light switch) semantically–, phonologically–, or functionally–related to peripheral objects (e.g., a hammer). The extent to which undesired behaviors can be spurred into action with distracters that bear little relation to targets remains to be demonstrated. Compared to previous findings, such a demonstration would be more informative regarding how ambient stimuli influence action in the real world, in which target objects often bear no apparent perceptual or semantic relation to incidental, background objects.

Can *unrelated* distracters elicit action? In addition to our primary manipulation, we took the opportunity to address this issue by varying the level of association between targets and distracters. Resembling natural environments, an *unrelated* condition presented targets (H, V, K) that were unrelated to the distracters. For the sake of comparison, resembling previous paradigms, a *related* condition presented targets (the music–related letters G, B, and D) that were subtly–related to the distracters (see below). This *relation* manipulation allowed us to compare the degree to which related and unrelated incidental distracters can elicit undesired behaviors. We made the strong prediction that, because action plans in musicians are activated in a blind fashion by music–related stimuli, distracter effects in musicians would be present even in the unrelated condition.

METHOD

PARTICIPANTS

Seventy–seven Yale University undergraduates participated for class credit or $8. To diminish experimental demand, they were queried about musical training only after the conclusion of the experiment. In a verbal debriefing, participants were asked a series of questions regarding musical training, including: Have you ever received any formal musical training? Have you ever been capable of reading musical notation without much effort? Would you consider yourself an expert sight–reader? On the basis of this information, two judges (former professional musicians) then divided participants into three categories: musician ($n = 46$), nonmusician (control, $n = 25$), or ambiguous ($n = 6$). There was perfect agreement among judges regarding the classification of participants. A participant was considered to be a musician if he or she reported the ability to read music above the level of a novice and to be a nonmusician if he or she reported having little or no musical training. Participants not falling squarely into these categories were regarded as ambiguous, and their data were excluded from further analysis.

PROCEDURE

To diminish demand characteristics, participants were informed that they were participating in a study of visual distraction. During training, participants were instructed to press specified keys on a computer keyboard when presented with certain visual targets (letters). Participants commenced each training trial by pressing the space bar when presented with a "Ready?" prompt (a question mark). After 600 ms, a fixation point (+) was shown at

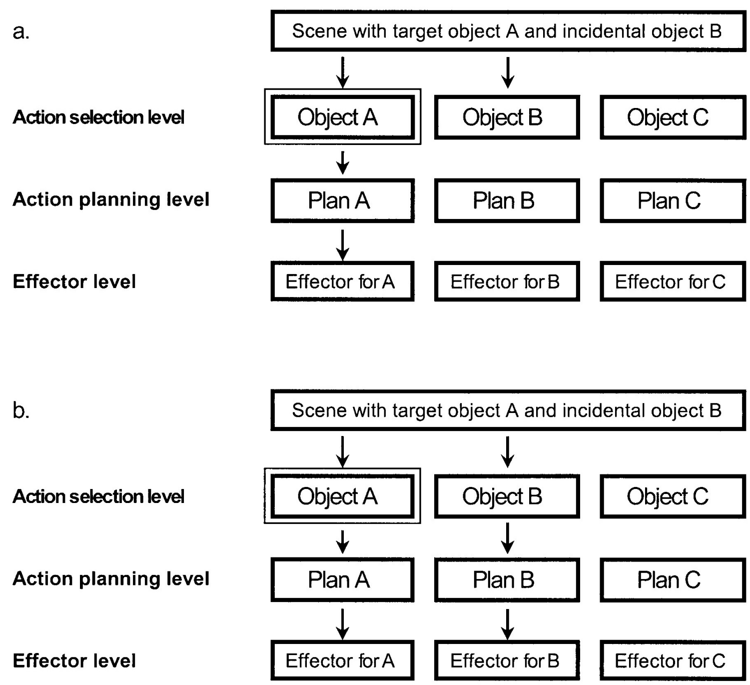

FIGURE 1. *Serial* (a) versus *cascade* (b) models of activation.

the center of the screen for 1000 ms. It was then replaced by one of the six target letters, which remained on the screen until the participant responded by pressing one of six black keys on a modified, white–keyed computer keyboard. On a standard keyboard, the position of these keys would occupy the positions of symbols T, 3, and 1 (for the *related* targets G, B, D) and U, 9, and / (for the *unrelated* targets H, V, K). Participants were instructed to rest their fingers on the keyboard so that they would always be touching these six keys. For the right hand, the thumb was on the H key, the middle finger on V, and the pinky on K. For the left hand, the thumb was on G, the middle finger on B, and the pinky on D. We made the strong prediction that distracter effects would be present in musicians even in the unrelated condition. Given the subtlety and weakness of our *relation* manipulation, it would not be surprising to find no increased idle–hand errors for the related condition. Hence, to diminish noise and increase the sensitivity of detecting related (and unrelated) effects, we did not intermingle target type within the same

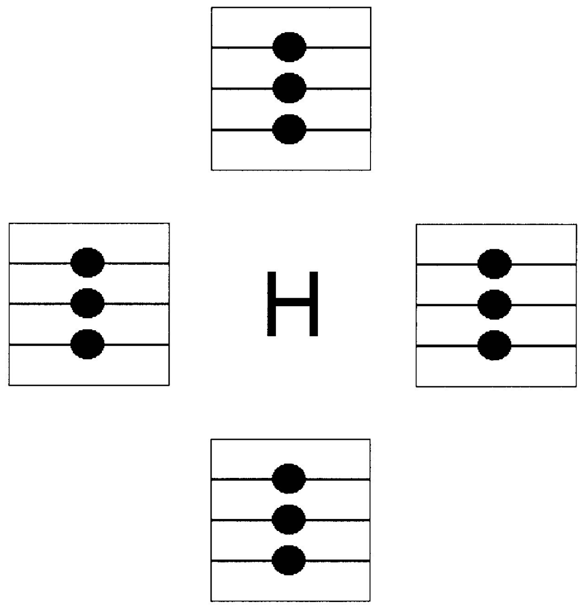

FIGURE 2. Sample distracter environment. Not drawn to scale.

effector and, following the flanker tradition (e.g., van Veen et al., 2001), did not counterbalance target–effector contingencies across subjects. Stimulus presentation and data recording were controlled by PsyScope experimental software (Cohen, MacWhinney, Flatt, & Provost, 1993). Stimuli were presented on a white, 43 cm Apple eMac computer monitor (60 Hz), with a viewing distance of approximately 48 cm. All letter stimuli were presented in 48–point Helvetica font. Piloting (n = 4) revealed that, for our purposes, the task was neither too difficult nor too easy and that the distracter manipulation was far from obvious.

The session began with a familiarization phase of 42 practice trials in which each target appeared an equal number of times in random order. Then there were training blocks recruiting one hand at a time (15 trials each); the presentation order of these blocks was counterbalanced across subjects. Last, there was a shorter block in which both hands were used (12 trials). Participants were then told that the remainder of the experiment (240 trials) would involve the same task, and that they should continue to respond to the letter in the center of the screen. Participants were encouraged to respond as quickly and as accurately as possible, and told to disregard any stimuli (distracters) that appear in the area surrounding the targets. As in training, 1 of the 6 letter stimuli was presented one at a time. Each target was shown at random a total of 40 times. An idle–hand error occurred when, faced with a target that referred to the fingers of one hand–arm [the left or the right hand], the participant made an error and that error consisted of using the other hand. For example, an idle–hand error occurred if the target was V and any key was depressed with the left hand, or if the target was D and any key was depressed with the right hand. Letter cues were presented with distracters resembling musical notation in only 10% (n = 24) of the trials. Music–related distracters surrounded the target (at 2.5 cm from center) and resembled standard notation for the notes G, B, and D (Figure 2). It should be noted that, though succeeding at resembling musical stimuli, these distracters violated the rules of musical notation and would be nonsensical to a sight–reader, just as English non–words (e.g., *bint*) can resemble real words (e.g., *hint*) but be nonsensical. To maintain some visual consistency between trials and diminish experimental demand, filler trials (n = 216) contained decoy distracters, which consisted of empty squares.

RESULTS

Following Woodworth and Schlosberg (1954), RTs below 200 ms and above 2000 ms were excluded from analysis, resulting in the removal of 3.1% (53 out of the 1704) of the music–related trials. When faced with music–related distracters, participants exhibited many kinds of errors, including hesitations (RTs > 2000 ms) and incorrect key presses. The proportions of correct responses were similar for musicians (M = .889, SEM = .013) and controls (M = .883, SEM = .022). When aggregating all error types (hesitations, idle–hand, and correct–hand errors), musicians did not err more than controls, $t_{unpaired}$ (69) = 0.257, p = .798. However, as predicted, musicians exhibited substantially more idle–hand errors than controls, $t_{unpaired}$ (69) = –2.082, $p < .05$ ($\eta_p 2$ = .06), but only when confronted with music–related (nonfiller) distracters (Figure 3).

In a mixed ANOVA analysis that included the filler, empty–square distracters (3.3% of filler data was removed after trimming), with *training* (musician vs. control) as a between–subjects factor and *distracter environment* (music–related vs. filler) as a within–subjects factor, there was no main effect from training, F (1, 69) = 2.362, p = .1289 ($\eta_p 2$ = .03), but, as expected, there was a main effect from distracter environment, F (1, 69) = 15.263, p = .0002 ($\eta_p 2$ = .18), in which more idle–hand errors were exhibited in the presence of the less frequent (and presumably more arousing) music–related distracters. Most important, there was a significant interaction between training and environment, F (1, 69) = 15.263, p = .0002 ($\eta_p 2$ = .08), in which

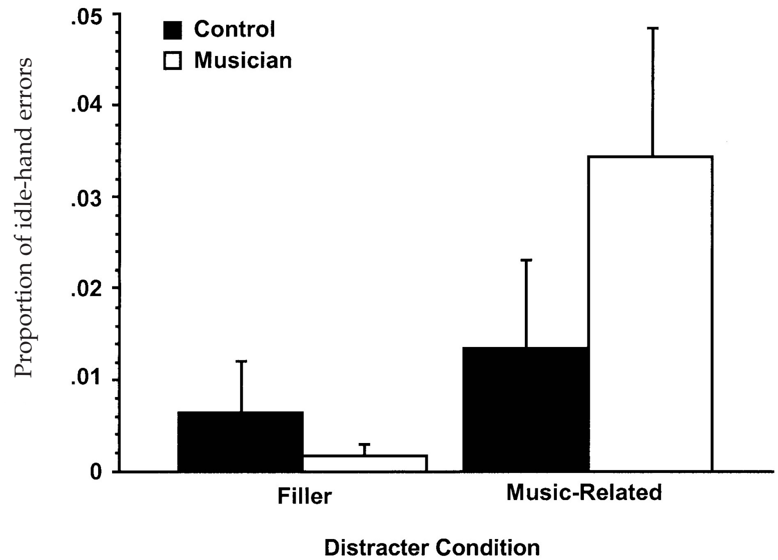

FIGURE 3. Mean proportion of "idle-hand" errors as a function of training (musicians vs. controls) and distracter environment (musical vs. nonmusical fillers). Error bars signify 95% confidence intervals.

only musicians exhibited significantly more idle–hand errors when confronted with music–related vs. filler distracters (t_{paired} [69] = 4.593, $p < .0001$). This was not the case for other kinds of errors. *Post hoc* tests revealed that musicians did not exhibit more hesitations than controls ($t_{unpaired}$ [69] = 1.064, $p = .291$) nor more correct–hand errors than controls ($t_{unpaired}$ [69] = .746, $p = .458$). As expected, for controls, the number of correct–hand and idle–hand errors was positively correlated ($r = .615$, $p = .0008$), but no such relationship was found for musicians ($r = –.041$, $p = .79$). The difference between these correlation coefficients ($z = –4.973$, $p < .0001$) supports the view that idle–hand errors are a special class of error for musicians.

Perhaps idle–hand errors were caused, not by the nature of distracters, but by the nature of targets (e.g., perhaps musicians happen to make more of these errors when targets referred to the left hand or the right hand). However, this hypothesis is inconsistent with the fact that the factor *target hand* did not influence the experimental results in any way and yielded no discernible effects: whether targets referred to one [e.g., G, B, D] or the other hand [e.g., H, V, K] did not produce any main or interaction effects upon any kind of error (*p*s > .20). This analysis supports the conclusion that idle–hand errors in musicians were caused by the nature of distracters. In short, idle–hand errors (whether executed by the left or right hand) resulted only in musicians and only from critical distracters. The nature of the target or effector was inconsequential.

Whether targets were related or unrelated led to virtually the identical pattern of results. Faced with music–related distracters, musicians exhibited roughly as many idle–hand errors when responding to related (M = .04, SEM = .01) and unrelated (M = .03, SEM = .01) targets. For controls, the respective values were M = .01 (SEM = .01) and M = .02 (SEM = .01). In other words, the intended target of action did not moderate the distracter effect. In a mixed ANOVA with *training* as a between–subjects variable and *relation* (related vs. unrelated) and *environment* as a within–subjects variables, there was no main effect of *relation*, F (1, 69) = .056, p = .81, no interaction between *relation* and *training*, F (1, 69) = .462, p = .50, and no interaction between the three factors, F (1, 69) = .401, p = .53. Only the aforementioned effects of *environment* and its interaction with *training* were significant (ps < .05). Together, these results strongly suggest that the effect could be caused by the presence of distracters alone.

In addition, *post hoc* RT analyses show that, overall, musicians were not any faster at the task than were controls ($t_{unpaired}$ [69] = .623, p = .535), ruling out that the difference in idle–hand errors stemmed from a speed–accuracy trade–off. When queried during debriefing, no participants were able to discern the true purpose of the study or of the manipulation, nor did any musician or control participant realize that the distracters were meant to resemble musical notation. All participants reported that they focused only on targets. We also examined whether the effect varied as a function of the particular instrument (e.g., piano vs. flute) on which the participant was trained or as a function of his or her level of expertise (e.g., novice vs. expert), but we did not observe any interesting contrasts (ps > .50).

DISCUSSION

Previous interference paradigms have documented the influence of incidental, action–related distracters in terms of indirect, RT effects upon an already ongoing, intended action. However, there had been no direct demonstration that such stimuli can actually lead to the unintentional expression of the actions linked to them. In line with cascade but not serial models, musicians exhibited more than twice as many idle–hand errors than controls when incidentally presented with stimuli resembling musical notation, even though distracters were not selected for action. This effect was predicted to occur only for musicians because only they were expected to possess distracter–relevant plans involving both hands. In addition, we demonstrated that such interference occurs even when targets and distracters bear no apparent relation—a situation that resembles natural scenes more so than those of previous paradigms. Again, in natural scenes it is seldom the case that distracters (e.g., books) happen to be related to targets (e.g., a cup) in some apparent way (e.g., semantically, functionally, phonologically, or perceptually).

Although supraliminal, distracters were *very* incidental in the sense that participants never responded to them, to similar objects, nor to objects ever appearing in those (peripheral) regions of the display. In traditional response–interference paradigms (e.g., flanker paradigms; Eriksen & Eriksen, 1974; Starreveld et al., 2004), distracters are in close proximity to targets (e.g., the letter *H* or an arrow) and are generally from the same class of stimuli as distracters (e.g., other letters or arrows). Unlike previous paradigms, the stimulus dimensions to be ignored in our experiment were irrelevant to the task at hand, making them more representative of the kinds of ambient stimuli (e.g., street signs, advertisements, tools, persons) that are of interest to the social psychologist. Being geometric shapes, distracters did not physically resemble letter targets in any way. It is difficult to imagine ways in which our stimuli could have been still more incidental without becoming imperceptible. In short, for the first time, unintentional behaviors were spurred into action even though elicitors were (a) very incidental, (b) not in the response set, (c) unrelated to targets, (d) first encountered and assimilated long ago, outside of the laboratory, and (e) not identified as the objects they were intended to resemble.

This extension of nonconscious action–plan research into situations involving ecologically–valid stimuli (i.e., action–related objects learned outside of the laboratory) was deliberately made at the cost of control of some potentially influential variables, such as the nature and amount of musical training in our sight–reading participants. Moreover, musical stimuli are special stimuli for musicians for multiple reasons beyond their ability to nonconsciously activate plans (e.g., these stimuli likely activate additional and different attentional and semantic processes in experts than in nonexperts). Yet we see no reason why or how such factors would lead, specifically, to idle–hand errors.

It has long been suggested that, in probabilistic terms, we are slaves to the stimuli forming our immediate environments. Yet, the mechanisms underlying such control have for the most part gone unaddressed. (For how the environment triggers habitual forms of these behaviors, see Wood, Quinn, & Kashy, 2002.) We believe that, as supported by research in cognition, neuroscience, and social psychology; and as consistent with the basic neurophysiology of perceptual processing (cf., Eriksen & Schultz, 1979; Ganz, 1975), a cascade model provides the best conceptual tool for illuminating the activation dynamics of the perception–behavior link. While contemporary ideomotor approaches (Hommel, Müsseler, Aschersleben, & Prinz,

2001) have resuscitated classic, pre–Behaviorist notions to address the *nature* of the mental representation of action plans and the mechanisms involved in the *acquisition* of these plans, a cascade approach focuses instead on the general dynamics within action production systems, that is, on the nature of the *activation* and *selection* of action plans. As well, in contrast to cybernetic models of action (Carver & Scheier, 1990), which focus on the interplay between controlled, goal–pursuit and affect over time, cascade models examine how (nonconscious) action plans are activated and selected at one moment in time.

This approach also addresses how qualitatively different (and dissociable) effects on judgment, behavior, motivation, and evaluation can all occur in parallel upon the presentation of a single stimulus scene (Bargh, 1997). Just as music–related stimuli can influence the behavior of musicians, so can the covert activation of concepts (e.g., library) prime corresponding—albeit more diffuse—action prone states. The labeling of these effects often reflect the subset of behaviors that the experimenter chooses to observe (e.g., speech volume), but this does not mean that the prime yielded only a single effect (Bargh, 2006).

This cascade approach is highly applicable to social settings and addresses one of the most fundamental questions of social psychology: How the mere presence of others can influence us in ways that escape our awareness (Zajonc, 1965; cf., Bargh, 2001). The model predicts that, just as with laboratory stimuli, social stimuli nonconsciously activate the behavioral dispositions with which they are associated, and explains aspects of the mechanisms giving rise to interpersonal influences, illuminating why one can repeatedly (and often unintentionally) find oneself acting in certain unselected ways around certain people. In addition, it makes the novel prediction that levels of response competition would be greater in the presence of individuals who, as social stimuli, elicit a wide array of actions (e.g., friend, coach) than in the presence of those who elicit a more limited array (e.g., bank teller, fast food restaurant clerk).

From this standpoint, action–related stimuli activate multiple action plans in parallel, and action production is driven by some form of selective disinhibition (Rumelhart, McClelland, and The PDP Research Group,1986), such that competitor plans are somehow inhibited or counteracted (regarding the role of consciousness in these processes, see Libet, 1999; Morsella, 2005; Shallice, 1972). Therefore, perceptions always lead to actions automatically, and all that can be done in the process of selection is to inhibit the execution of undesired plans (but see Macrae, Bodenhausen, & Milne, 1995). (One can readily imagine scenarios that illustrate the evolutionary advantage of having responses potentiated regardless of an actor's present intentions; see Bargh, 1997.) Evidence of such activation is obvious in action slips (Heckhausen & Beckmann, 1990) and is most dramatic in some neuropsychological conditions. Caused by damage to the frontal lobes, the syndrome *utilization behavior* induces a state of disinhibition in which patients are incapable of suppressing actions that are elicited by environmental, action–related objects (Lhermitte, 1983). For example, a patient afflicted with this syndrome will manipulate an object (e.g., a hammer) even when instructed not to do so (Rossetti & Pisella, 2003).

It is important to note a caveat or limit to the kinds of incidental stimulus effects on action that should be expected: that the nonconsciously suggested action be somehow applicable to the current situation (see Förster & Liberman, in press; Higgins, 1996); that the experimental task affords the opportunity for behavioral expression of the primed action plan. (For a treatment of how such applicability can at times be overriden by accessibility, see Higgins & Brendl, 1995.) For example, incidental stimuli should not be capable of eliciting behaviors that are clearly “out of the blue” and “contextually–inapplicable” such as singing during the test–phase of our study. Yet our data suggest that such stimuli can nevertheless elicit acts that are (at the least) task–irrelevant, unrelated to target stimuli, and run counter to one’s current task goals (e.g., that of pressing the target key), which in our view is a strong demonstration of the ability of incidental stimuli to produce nonconscious action tendencies.

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