NOTES AND COMMENT

On finding negative priming from distractors

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Negative priming from distractors has attracted considerable interest because it appears to reveal a fundamental mechanism of selective attention. Recently, the phenomenon has become muddled because it can be explained in far too many ways. This may partly be because the empirical foundation for the phenomenon has been handicapped by an overreliance on a simplistic comparison of a single experimental condition with control. A sounder approach requires that we collect data that can rule out alternatives to the hypothesis we might favor or test. Regardless of the paradigm used, we propose collecting data from a much fuller set of conditions than is typical. Despite the variety of underlying explanations, we show that the various theories that attribute negative priming to ignoring the distractor predict a common pattern of results across the full set of related conditions. Theories, such as inhibition of return, that do not attribute the cost in performance to ignoring the distractor do not predict this pattern.

The term *negative priming* (Tipper, 1985) can be used to describe any negative impact on performance caused by the previous presentation of a stimulus. Within the literature in which this term has been used, negative priming has often been shorthand for the phrase *negative priming from ignored distractors* (Fox, 1995; Neill & Mathis, 1998). The present commentary is specifically about *negative priming from distractors*, and when this is what we mean we will refer to *NPD*. Only when we use the term *negative priming* is the more general sense intended.

NPD was discovered by Dalrymple-Alford and Budayr (1966), who, using a variation of the Stroop paradigm, found that when the target on the current trial was the same as the distractor on the previous trial, performance was worse than if a new target and distractor were used. NPD was first studied explicitly by Neill (1977) and later by Lowe (1979) and Tipper (1985).

Derived from these seminal studies, the most basic traditional NPD experiment consists of running pairs of trials in sequence, a prime trial followed by a probe trial. The critical NPD condition occurs when a distractor on the prime trial becomes a target on the probe trial, something we call the *distractor→target* condition.¹ This is compared with a baseline condition for which the probe has a new target and a new distractor that are not related to the prime, often called the *unrelated* control condition. A

reduction in performance in the distractor→target condition, relative to the control, is the traditional hallmark of an NPD effect.

This basic measurement highlights the exciting component, and commensurate broad interest, in NPD. Whereas performance in response to a given target stimulus may be reduced for various reasons when it is preceded by another stimulus (e.g., habituation, response reconfiguration, etc.), in NPD the critical component is that the immediate cause of the deficit in performance is directly attributable to the current target item's having recently been a distractor. It is this methodological characteristic that makes NPD interesting, because it permits one to generate interesting hypotheses about the processing of information that was not the primary focus of the task.

Nevertheless, the typical distractor→target – control measurement of NPD is in and of itself not sufficient to ensure that a given negative-priming effect is NPD. This is primarily a problem with the control condition, which differs from the distractor→target condition in more than one way. This is not a reason to abandon the control condition. On the contrary, as we will show below, it is integral to a study of NPD. But it is a reason not to rely on the control condition as the sole arbiter of whether NPD has occurred or, more specifically, whether what affects performance is the target's prior status as a distractor.

A Full Set of Conditions

An examination of all of the possible prime and probe relationships in the basic traditional NPD paradigm is shown in Table 1.

Studying this variety of possible conditions² makes it easier to see the possible results that could occur and allows one to question the specific attribution of a particular negative-priming effect to the fact that the previous item was a distractor. For example, what if all of the other conditions are worse than control? Then it would be difficult to argue that any cost in the distractor→target condition would be specifically due to the fact that the probe item was previously a distractor. In fact, any other condition's performance being worse than that in the control condition would bring the NPD attribution into question. A theoretical argument would need to be developed to explain why two costs have different causes. The only exception to this is the switch condition, wherein there is an embedded distractor→target manipulation. Alternatively, performance in the switch condition may be better than that in the control condition while the distractor→target performance is worse. This would also bring into question an NPD explanation of the distractor→target cost,

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Table 1
Naming Conventions of the Possible Probe Conditions
(Prime–Probe Relationships) in Three Popular Variants
of the Negative Priming From Distractors Paradigm

Condition	Stroop	Letter Identity	Location
Prime	RED (green)	-AC	_ 0 _ +
Congruent Probe			
Repeat	RED (green)	-AC	_ 0 _ +
Target→target	BLUE (green)	-AB	_ 0 + _
Distractor→distractor	RED (blue)	-BC	0 _ _ +
Incongruent Probe			
Target→distractor	GREEN (blue)	-BA	_ + 0 _
Distractor→target	BLUE (red)	-CB	_ _ + 0
Switch	GREEN (red)	-CA	_ + _ 0
Unrelated Probe			
Control	YELLOW (blue)	-BD	0 _ _ +

Note—Each condition is illustrated with one exemplary probe possibility (when there are more than one) in relation to the particular prime shown. There are seven probe conditions altogether. In Stroop, the color of the letters, the target, is in parentheses after the word; in letter identity, the left letter is the target; and in localization, the 0 is the target.

because it would have to be explained why this cost did not also occur in the switch condition.

These examples of empirical puzzles that could occur (and sometimes do) serve to highlight one problem with the typical method of measuring NPD: The control condition alone is not sufficient to attribute a cost found in the distractor→target condition to the target's having been a distractor on the prime. Ideally, a control condition differs from an experimental condition by a single manipulation. Looking at the conditions in Table 1, it can be seen that the control condition deviates the most from the distractor→target condition, with which it has nothing in common. The response to this complaint is not to seek a better control condition (since there is no single condition that can serve this role) but, rather, to obtain a richer data set, including multiple conditions that will allow the investigator to rule out alternative explanations. One critical condition, as will be explained in the next section, is the target→target condition, because a cost that is attributable to ignoring a distractor should not also be generated by attending to a target. It follows that, because the control condition is not sufficient, researchers would be well advised to collect data from more conditions—ideally, all the possible prime–probe relations. This not only is theoretically useful, but also, when done in a mixed design, is one relatively simple way to avoid untoward prime–probe contingencies that can challenge an author's conclusions (see Christie & Klein, 2001, for a discussion of this topic).

A Case in Which the Distractor→Target Cost Diagnostic Was Insufficient

The location paradigm (see the last column of Table 1), first used by Tipper, Brehaut, and Driver (1990), has been a very popular method for exploring NPD. A target and a distractor are presented in different locations, and the participant must respond, usually in a highly stimulus–response compatible manner, indicating the location of the target. In the control condition, the current trial's target and distractor are presented in new locations that were

unoccupied on the previous trial. In the distractor→target condition, the target on the current trial is presented in the same location as the distractor on the previous trial, while the distractor is presented in a previously unoccupied location. Experiments using this method reliably show a robust distractor→target cost, relative to control. This cost is typically used to assert that NPD exists for spatial locations.

Tipper et al. (1990) first deduced that the distractor→target – control diagnostic for testing NPD is not sufficient to attribute any cost found to the current target's previous status as a distractor. They suggested that negative priming in the location paradigm might actually be due to attending the distractor, rather than ignoring it, and that, if so, such a cost would also be visible in the target→target condition. The proposed mechanism would be inhibition of return (IOR):

It is possible that the negative priming effect that we observed in Experiment 1a might be a form of inhibition of return. Suppose that attention is briefly drawn to a distractor in the prime display (thus producing the interference effect). The mechanism of inhibition of return would then produce the delayed response observed when the probe target appears in the same locus as the distractor in the ignored-repetition condition. If this account is correct, then a delay in response should also be observed when the probe target appears in the same location as the previous prime target in the attended-repetition condition. Indeed, inhibition of return has been observed following a prime that is a relevant stimulus to which a response has been made (Maylor & Hockey, 1985). (Tipper et al., 1990, pp. 495–496)

IOR, as its name implies, is a mechanism whereby spatial attention is inhibited from returning to previously attended locations (Klein, 2000; Posner & Cohen, 1984; Posner, Rafal, Choate, & Vaughan, 1985). By running a target→target condition, Tipper et al. (1990) sought to verify that the negative-priming effect was not merely an IOR effect. As the quotation implies, had they found a cost in the target→target condition, an IOR account for the cost in the distractor→target condition could not have been ruled out. By Occam's razor, it would be more parsimonious to assume one source (IOR) of the two costs than two (IOR and NPD). Tipper et al. did not find a cost in the target→target condition; therefore, they quite logically concluded that the distractor→target cost was caused by NPD, rather than by IOR. However, there was a bias in the design of their experiment (see Christie & Klein, 2001), so that participants were likely to expect a target→target trial because these trials happened more frequently than chance. Given that IOR may not occur (or if it does, may be overshadowed by facilitation) if one voluntarily maintains attention at a location, the experiment was not a fair test of IOR.

Christie and Klein (2001; Frame, Christie, & Klein, 1993) ran replications of Tipper et al. (1990), in which they attempted to eliminate any bias or contingencies in the prime–probe relationships. They accomplished this by using all of the conditions in Table 1. And they used

them in such a way that their frequency of occurrence was directly proportional to their possibility of occurrence (see note 2).

As can be seen in Figure 1, Christie and Klein (2001) found that there was consistently a cost in performance (as compared with the control) in the target→target condition, as well as in the distractor→target and switch conditions. This is precisely the finding that would have led Tipper et al. (1990) to conclude, as did Christie and Klein, that they had found IOR instead of NPD. Other findings further reinforced Christie and Klein's conclusion that what had previously been called NPD in this paradigm was, instead, IOR. For example, they found improved performance, relative to control, when the probe distractor was in a previously occupied and, hence, hypothetically inhibited location, independently of whether that location had contained a target (target→distractor) or a distractor (distractor→distractor). So long as targets and distractors are likely to have been attended on the prime, this is what would be expected from an IOR account, because IOR would reduce the likelihood that the probe's distractor would attract attention.

Through experiments that did not require selection on the prime, Milliken, Tipper, Houghton, and Lupiáñez (2000) highlighted the similarity between IOR and location NPD methods. Although we disagree with their conclusion (we believe it to be an overgeneralization) that NPD and IOR are the same mechanism, their results converge with ours in showing that the negative priming seen in the location paradigm is more likely caused by IOR than by NPD.

NPD is a cost in performance attributable specifically to the current target's prior status as a distractor. We have just shown why, by simply comparing the distractor→target and control conditions, a researcher cannot make this attribution. Whereas Christie and Klein (2001) provided one example of what the data might look like should the effects not be NPD, it remains to be seen what the pattern of results across the full set of conditions listed in Table 1 would look like should an NPD effect be found. As will be shown in the next two sections, all theories of NPD predict a general *congruency* pattern across the six non-control conditions shown in Table 1, and a specific ordering of these six conditions is predicted when two widely

Figure 1. Reaction time and error data from a spatial negative-priming study (Christie & Klein, 2001, Experiment 3).

accepted, pretheoretical assumptions are added. Whereas the confirmation bias that plagues everyday (as well as scientific) reasoning may cause researchers to neglect to use some of these conditions, we hope that the present discussion will encourage the widespread use of the full set of conditions.

The Congruency Pattern: General and Specific

The relation between a prime and a probe can be either congruent or incongruent. Congruent prime–probe pairs are ones for which a probe item appears with a target or distractor property that is the same as the one that appeared on the prime trial. Incongruent prime–probe pairs are ones in which an item from the prime appears again on the probe but is changed from target to distractor or from distractor to target. In Table 1, the conditions labeled repeat, target→target, and distractor→distractor are congruent. The conditions labeled target→distractor, distractor→target, and switch are incongruent. The unrelated control condition, in which both the target and the distractor on the probe are different from the prime, does not have a positive or negative congruency, and therefore, only the six related conditions are critical for describing, and determining the presence of, the congruency pattern, described below.

All theories of NPD predict that when the relation between the prime and the probe is congruent, performance will be better, whereas when the relation between the prime and the probe is incongruent, performance will be worse. Why they predict this *general congruency pattern* will be covered in the next section (see also Christie, 2003, for a more detailed presentation). This *congruent better than incongruent* pattern, which is predicted by every theory, will be referred to as the *congruency pattern*.

An even more specific pattern is likely to be observed because of two pretheoretical assumptions that we believe to be generally accepted. The first pretheoretical assumption is that distractors interfere with target processing, and the second is that prime–probe congruencies involving targets will affect performance (responses to probe targets) more than will prime–probe congruencies involving distractors. This first assumption simply restates the meaning of the term *distractor*. Unfortunately, it is also only implicit in some explanations of NPD, and we wish to assert that for our purpose, which is to understand negative priming from distractors, it always occurs. Indeed, if an irrelevant stimulus does not cause any interference, then, by definition, such a stimulus is not a distractor. The second assumption is not explicit in any theory of NPD but is a basic principle of performance when targets and distractors are processed. Processing of a target affects performance directly, whereas processing of a distractor affects performance only indirectly to the degree that it interferes with target processing. When there is a prime–probe–target congruency or incongruency (e.g., target→target and distractor→target, respectively), the degree to which it can improve or interfere with performance is directly related to processing of and responding to the target. In contrast, when there is a prime–probe–distractor congruency or incongruency (distractor→distractor and

target→distractor, respectively), it is only the probe distractor's effect on target processing that can be affected. Typically, then, the direct effects on performance of prime–probe–target congruency will be stronger than the indirect effects of prime–probe–distractor congruency.

By combining these assumptions with the general congruency pattern (see Table 2), it is possible to predict the following precise ordering of performance on related trials, from best to worst: repeat, target→target, distractor→distractor, target→distractor, distractor→target, and switch. There are only two published letter identification studies (middle column of Table 1) that have reported results from all the conditions (Neumann & DeSchepper, 1991; Stadler & Hogan, 1996; see Christie, 2003, for further replications), and the data from both of these studies conform well to this specific congruency pattern, which is illustrated in Figure 2 using the data from Stadler and Hogan.

Performance in the control condition could fall between that in the worst-performing congruent trial, distractor→distractor, and that in the best performing incongruent trial, target→distractor, as happened in the Stadler and Hogan (1996) data presented here. However, the congruency pattern is about related trials and does not speak to the exact position of the control condition. As will be argued below, several theories of NPD do not necessarily predict what control condition performance will be with respect to related trials, although all theorists have assumed that it will be better than that for the distractor→target condition.

Given that the specific congruency pattern has been independently replicated in the literature, using a letter identity paradigm (Christie, 2003; Neumann & DeSchepper, 1991; Stadler & Hogan, 1996), and that it cannot be explained by the mechanisms that generate IOR in the spatial negative-priming paradigm (as per Christie & Klein, 2001, above), it is highly probable that these different paradigms reveal different mechanisms and that the letter identity paradigm involves a genuine manifestation of NPD, as distinct from IOR. Note that if one collects data only from the distractor→target and control conditions, one cannot distinguish between IOR and NPD.

How Do Theories of NPD Predict the Congruency Pattern?

Two broad categories of theories of NPD will be discussed here: attention and memory. We found nine variations of these in the literature (see Table 3), only some of which will be specifically mentioned. The critical point (which is discussed in detail in Christie, 2003) is that all nine variations predict the congruency pattern.

Selective attention theories. The first class of theories is broadly based on selective attention. All four explanations listed in Table 3 under this category predict the congruency pattern. Under the selective inhibition account (Neill, 1977; Tipper, 1985), target selection is accomplished by activating the target item and inhibiting the distractor item. The residual effect of inhibition of the prime distractor makes subsequent items sharing its properties more difficult to process when they appear as the

Table 2
Components of the Congruency Pattern

Condition	Letter Identity	Congruent?	Target Congruent?	Distractor Congruent?
Prime	-AC			
Congruent Probe				
Repeat	-AC	yes	++	+
Target→target	-AB	yes	++	
Distractor→distractor	-BC	yes		+
Incongruent Probe				
Target→distractor	-BA	no		—
Distractor→target	-CB	no	--	
Switch	-CA	no	--	—
Unrelated Probe				
Control	-BD			

Note—All extant theories of negative priming from distractors predict the congruency pattern (that performance on congruent probe trials will be better than that on incongruent probe trials, indicated by “yes” and “no” in the “Congruent?” column). In addition, the pre-theoretical assumptions discussed in the text generate additional benefits (+) and costs (—) due to target and distractor congruency, with the former larger than the latter. When these benefits and costs are combined with the congruency pattern, performance on the related (noncontrol) conditions will be ordered (from best to worst) as illustrated here, using the letter identity paradigm for which this order is robustly obtained (see Figure 2).

probe target. A performance deficit ensues, thus generating NPD. Target repetition benefits are similarly explained by residual activation of the attended target. Subsequent revisions of the theory, as well as the dual-channel theory (Stoltzfus, Hasher, Zacks, Ulivi, & Goldstein, 1993), do nothing to undermine this central idea but either generalize it (Keele & Neill, 1978; Lowe, 1985; Treisman & Gelade, 1980) or make it more explicit (Houghton & Tipper, 1994; Houghton, Tipper, Weaver, & Shore, 1996).

Although the original authors did not explicitly describe the congruency pattern, it can nevertheless be derived from the fundamental explanations that were given. If the target activation or distractor inhibition pattern is matched, performance will be improved. Repeat, target→target, and distractor→distractor performance will be improved because the pattern of activation, inhibition, or both is matched and does not need to be reestablished. The target will already be activated above a resting level, and the distractor will already be inhibited below a resting level. Conversely, all of the incongruent trials have conflicting patterns of activation. The distractor→target condition is the only one specifically mentioned in the theory. But the target→distractor condition should also result in a performance decrement, because the distractor on the probe will be more highly activated and, therefore, should interfere more. The switch condition should result in even worse performance, because it is a combination of other incongruent conditions. On the switch trial, the probe target is inhibited, and the distractor is activated, making the task even more difficult than that in the distractor→target condition. Because all of these relationships are about stimulus activation levels, relative to a neutral level of activation, the selective inhibition hypothesis strongly predicts that the control condition will fall in the center, between congruent and incongruent performance.

Memory-based explanations. The first memory-based or mismatch theory of NPD was proposed by Neill and Valdes (1992). It was inspired by Logan's (1988, 2002)

automaticity theory, and it relegates attention to a passive role with respect to the NPD effect. In a framework labeled *transfer inappropriate processing/transfer appropriate processing* (TIP/TAP), this was generalized by Neill and Mathis (1998) to go well beyond the scope of NPD. But for the specific case of NPD, these two memory-based accounts are very similar.

In TIP/TAP, retrieval of a prior trial causes NPD through incompatibilities between the memories of recent processing of an item and the processing required at present. On the prime trial, one records the target as something requiring a response and the distractor as something to ignore. This memory is crucial to developing the faster, automatic processing that typically occurs with repeated encounters with the same stimuli (Logan, 1988). When stimuli are repeated, the previous episodes are retrieved and can help performance. However, if, on the probe trial, the previous distractor is presented as a target, the memory that it was just ignored will be in conflict with the present task requirement to attend and respond to it. This will cause a drop in performance.

The congruency pattern follows directly from this theory. Indeed, according to this theory, interaction between the contents of retrieved memories (from the prime) and present stimulation (on the probe) is the proposed mechanism for the general effect of congruency.

An interesting twist with the memory theories is that performance in the control condition may not fall between congruent and incongruent performance. Drawing directly from the foundation for the TIP/TAP theory—automaticity theory (Logan, 1988)—it appears that the control condition is unique in that none of its component stimuli are likely to benefit from trace activation of the previous trial, and a response (whether correct, as on repetition trials, or incorrect, as on incongruent trials) is less likely to be retrieved. Consequently, the response on a control trial must be algorithmically calculated, and performance will

Figure 2. Reaction time data from a letter identity negative-priming experiment (Stadler & Hogan, 1996).

be unassisted, but also unhindered, by prior memories. Whereas performance in the control condition should be worse than that in the congruent conditions, it may or may not be better than that in the incongruent conditions. The reason is that on incongruent trials, there are two opposing factors that may affect performance: Retrieval of the previous response will hurt performance (as when an item has a *do not respond* code), whereas the recent prior perceptual processing of the stimuli will benefit performance (Neill & Joordens, 2002). If the benefits should outweigh the costs, performance in the incongruent conditions may be speeded, relative to control. Thus, in contrast to the

selective inhibition theories, this theory is uncommitted with respect to the position of the control condition, except that it will be slower than congruent conditions.

There are a couple of further unique memory theories that bear brief mention. *Hesitation* is what we have chosen to call an inventive explanation of NPD that was proposed by Milliken, Joordens, Merikle, and Seiffert (1998). It relies on a principle of automaticity (Logan, 1988) that is the same as that used in the episodic retrieval and TIP/TAP theories. However, under the hesitation account, the mental events that occur to generate the deficit in performance seen as NPD are very different

Table 3
Explanations of Negative Priming From Distractors
That Predict the Congruency Pattern

Theory	Article
Attention Theories	
Selective inhibition	Neill (1977)
Code coordination	Lowe (1985)
Selective inhibition model	Houghton & Tipper (1994)
Dual channel	Stoltzfus, Hasher, Zacks, Ulivi, & Goldstein (1993)
Memory Theories	
Episodic retrieval	Neill, Valdes, Terry, & Gorfein (1992)
TIP/TAP	Neill & Mathis (1998)
Hesitation	Milliken, Joordens, Merikle, & Seiffert (1998)
Perceptual mismatch	Park & Kanwisher (1994)
Selection mismatch	MacDonald, Joordens, & Seergobin (1999)

Note—TIP/TAP, transfer inappropriate processing/transfer appropriate processing.

from those encountered in episodic retrieval. The way this theory predicts the congruency pattern has been fully treated in Christie (2003).

Another class of memory theories includes the perceptual mismatch theory (Park & Kanwisher, 1994) and the selection mismatch theory (MacDonald, Joordens, & Seergobin, 1999). The latter is an elaboration that deals with some fundamental problems in the former. But both rely on the fact that items between prime and probe vary in similarity across conditions. Although fundamental evidence for the latter theory has been strongly discredited (Mackintosh, Mathews, & Holden, 2002), it is still the better of the two explanations of NPD, and both of them match the congruency pattern equally (see Christie, 2003).

The Control Condition

Given that there is so much agreement across theories about the congruency pattern for the related conditions, it might be suggested that the control condition is not necessary and that one could assess NPD merely by testing for the congruency pattern among related conditions. Disregard of the control condition is not recommended, for the following two reasons. First, the relative position of the control condition can potentially be used to distinguish among the theories of NPD described below. Second, whereas one might detect the presence of NPD without the control condition, one could not detect IOR without it.

In general, memory-based or mismatch theories do not precisely locate the control condition with respect to the related conditions. Nevertheless, with memory-based theories, the control condition performance must be poorer than performance in congruent conditions and potentially poorer than that in all conditions, because retrieval of the trace of the prime cannot help performance. In the mismatch theories, the control condition is also a mismatch in comparison with the prime, and performance is potentially as poor as that in the distractor→target or even the switch condition. However, the selective-inhibition-based theories explicitly place the control condition between the congruent and the incongruent conditions.

Thus, the unrelated control condition can be used to parse the major categories of NPD theories. An NPD effect, demonstrated by data conforming to the congruency pattern, but in which the control condition does not rank between congruent and incongruent conditions, might best be explained by one of the nonattentional theories of NPD. The converse is not necessarily true: It is entirely possible for the control condition to fall between congruent and incongruent conditions under the memory-based theories. However, the relative position of the control condition should be sensitive to a variety of nonattentional manipulations that may shift the degree of benefit one gets for merely having processed the stimulus before or the degree to which one recalls the specific previous processing that conflicts with the present task. Therefore, across a range of manipulations, the control condition should stay in the center under attention theories but be able to change position under memory theories.

Where to Go Next

NPD is more complex to test and measure than is generally acknowledged. A pattern of results across all related conditions in the prime–probe paradigm, which we have called the congruency pattern, is universally predicted by existing theories of NPD, and a specific ordering of the six related conditions is predicted by all theories when two simple pretheoretical assumptions are accepted. This specific pattern has been robustly supported in the letter identity NPD paradigm (see Figure 2; Christie, 2003; Neumann & DeSchepper, 1991; Stadler & Hogan, 1996), wherein we can confidently attribute deficits in performance in the distractor→target trial to the fact that the current target was previously a distractor. In contrast, the congruency pattern has been remarkably violated in the location NPD paradigm (Christie & Klein, 2001; see Figure 1). Christie and Klein concluded that the distractor→target cost could not be specifically attributed to the current target's previous status as a distractor. A simple distractor→target – control subtraction would not have been able to make these distinctions.

We suggest that all of the conditions necessary to test the congruency pattern and the control condition should be included in future experiments for four very important reasons. First, when the congruency pattern is obtained while NPD is not present in the standard subtraction score, the pattern can be used to assert that NPD is present. Second, using the full set of conditions shown in Table 1 contributes a much richer database for the modeling of NPD or whatever processes are hypothesized to be operating in the task at hand. Indeed, a significant contribution of the richer database we are recommending is that it enables researchers, through a process of model fitting, to derive theoretically motivated parameter estimations of underlying processes (see, e.g., Christie & Klein, 2001), such as those illustrated in Table 2. Third, NPD findings in the literature that are based on the simplistic subtraction score might be overturned when substantial departures from the congruency pattern are obtained (see, e.g., Christie & Klein, 2001). Finally, including all of the possible conditions (in proportion to their possibility of occurrence) prevents participants from using the prime to predict important properties of the probe, whether through insight or associative learning.

In examining over 160 studies of NPD, we are aware of only 6 (at the time of this writing) in which a full enough set of conditions was used to avoid the untoward influences and in which data have been reported that would allow the reader to acquire a full picture of the pattern of results (and an assessment of the degree to which the congruency pattern is obtained). The currently large body of findings that lack sufficient conditions to confidently attribute observed negative-priming effects exclusively to the prime distractor and, therefore, conclude that they are NPD effects, should thus be revisited.

We believe that following our recommendation to collect data from the full set of possible conditions will bring the field closer to Meehl's (1990) ideal of psychology as a science (wherein one makes more explicit predictions and relies less on hypothesis testing) and will help clarify the current muddle that exists in the field of research on NPD.

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NOTES

1. This condition has also been referred to as *ignored distractor* or *related*. *Ignored distractor* burdens the trial description with both theoretical and psychological baggage. We do not know whether the distractor was ignored, only that an overt response was not made to it. Furthermore, the distractor→distractor condition can be confused with the distractor→target condition when such terminology is used. *Related* is simply too vague, because there is more than one probe condition related to the prime. The present nomenclature is similar to that used by Neumann and DeSchepper (1991) and is the same as that used by Christie and Klein (2001).

2. Running all possible events need not entail also running a larger number of trials than is typical in the NPD literature. However, given that the typical paradigm has 2 displays per trial and 12 possible displays, the number of possible prime-probe combinations is relatively small for a cognitive psychology experiment: 144 basic trial pairs distributed across the seven conditions. One can easily run this two or three times per participant in order to get stable estimates of performance in conditions with relatively small *ns*, such as repeat or switch (due to there being only a few ways in which they could possibly occur).