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Authors' Response

The correspondence metaphor of memory: Right, wrong, or useful?

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Abstract: Our response to the commentators covers four general issues: (1) How useful is our proposed conceptualization of the real-life/laboratory controversy in terms of the contrast between the correspondence and storehouse metaphors? (2) What is the relationship between these two metaphors? (3) What are the unique implications of the correspondence metaphor for memory assessment and theory? (4) What are the nature and role of memory metaphors in memory research? We stress that the correspondence metaphor can be usefully exploited independent of the real-life/laboratory controversy, but that a variety of other metaphors, including the storehouse, should also be utilized in order to more fully capture the myriad facets and functions of memory in everyday life.

We thank the commentators for their thoughtful and stimulating responses to our target article. In the article, we attempted to integrate a rather broad and complex array of interrelated issues at various levels of analysis: meta-theoretical, theoretical, methodological, and empirical. Hence it is not surprising that different commentators chose to address different subsets of those issues from a variety of viewpoints. Our response is organized around several general themes that emerge from the commentaries.

R1. Motivation and goals of the article

We first address some of the major points concerning the take-home message of the article. Because some of its motivations and goals may have been misconstrued by some of the commentators (and may likewise be misconstrued by other readers), we begin by outlining the essential thread of our argument: (1) Our examination of discussions of the real-life/laboratory controversy revealed three different dimensions around which the controversy may be seen to revolve; these dimensions, although correlated in the reality of memory research, are not logically interdependent. (2) At the same time, a survey of the work carried out under the banner of everyday, ecological memory reveals a unique preoccupation with the accuracy and faithfulness of memory. This preoccupation has little parallel in the traditional, laboratory approach to memory, which has focused almost exclusively on memory quantity. (3) We proposed that the focus on memory accuracy discloses a way of thinking about memory, embodied by the correspondence metaphor, that is different from the one reflected by the storehouse metaphor that has guided traditional laboratory research. (4) Because the meta-theoretical shift toward the correspondence metaphor has not been generally acknowledged, the study of memory correspondence continues to be constrained by theories and assessment methods, originally derived from the storehouse approach, that are not well suited to express the unique concerns raised in many discussions of memory accuracy and distortion. (5) We accordingly undertook to explicate the logic of the correspondence metaphor and to show how its exploitation in memory research and assessment could engender a bona fide psychology of memory correspondence to complement the quantity-oriented tradition. (6) We demonstrated how such an endeavor might be particularly useful in capturing some of the dynamics of memory in real-life situations and at the same time applicable in laboratory research contexts.

R1.1. Regarding the real-life/laboratory controversy. As should be clear from the foregoing outline, although our work was prompted by the real-life/laboratory controversy, our main goal was not to explain or resolve the controversy, but rather to explicate the metaphorical contrast that emerges from it and to show how that contrast can be utilized independent of the controversy. Thus, for instance, **Bruce** is mistaken in stating that "the principal issue that it [the target article] attempts to sort out is the difference between laboratory and naturalistic memory research." Because Bruce feels that the everyday/laboratory controversy has essentially dissipated, he believes that our analysis is therefore a "post mortem." A similar concern is expressed by **Kvavilashvili & Ellis,** who state - we hope rhetorically - that "the primary aim of the current target article is to demonstrate that the controversy has not been resolved."

Of course, some other commentators were simply not convinced that our analysis in terms of metaphors captures the essence of the controversy (see sect. R2).

As just noted, however, our primary aim was to use the real-life/laboratory controversy as a vehicle for revealing the more fundamental distinction between the two alternative conceptions of memory. Therefore, whether or not our analysis helps clarify some aspects of the controversy, we entirely agree with **Kvavilashvili & Ellis** that the contrast between the correspondence and storehouse metaphors is "sufficiently important to stand alone without reference to the everyday/laboratory controversy" (see also **Kruglanski** and **Winograd** for similar comments).

R1.2. Regarding the correspondence/storehouse distinction. A second misperception of our intention may underlie some of the commentators' attempts to defend the storehouse-guided, quantity-oriented approach to memory against the perceived threat of correspondence hegemony. Several commentators argue that not only is the storehouse metaphor alive and well, but that it can still make valuable contributions to the understanding of memory. In fact, some went as far as to propose a division of labor between the two metaphors: **Bahrick** maintains that whereas the correspondence metaphor is useful for capturing reconstructive memory processing underlying memory distortion, the storehouse metaphor is useful for capturing replicative processing underlying memory loss. **Schwartz** believes that the correspondence metaphor is well suited for inspiring functional models of memory, but that the storehouse metaphor is more suited to guide the development of structural process models (see also **Kruglanski** for a similar view).

We certainly agree that the storehouse metaphor is useful in capturing aspects of memory to which the correspondence metaphor is not suited, although we do not think that the correspondence metaphor need be limited either to reconstructive processing or to functional modelling (for an example of a correspondence-oriented process model that may be applied to "replicative" memory, see Koriat & Goldsmith, in press b). Perhaps, despite our explicit endorsement of "metaphorical pluralism" (see sects. 6.2 and R6.1), we are to blame for the impression that we were trying to bury the storehouse metaphor. First, we deliberately presented an extreme and hence somewhat primitive version of that metaphor in order to more clearly reveal its underlying logic. Of course, we also pointed out that modern storehouse-guided models have evolved considerably in sophistication and in their ability to deal with issues such as representation and retrieval (sects. 2.1 and R5). However, we admit that we were not particularly concerned about demonstrating the viability of the storehouse metaphor. Thus, **Bjork & Wickens** and **McNamara** are quite right in emphasizing that modem quantity-oriented models have come a long way from their verbal-learning ancestors and have much to contribute.

Second, our main interest is in promoting the correspondence metaphor as a viable alternative to the storehouse metaphor in guiding memory research. As we pointed out (sect. 3), unlike the situation in traditional, storehouse-guided, quantity-oriented research, little effort has been invested in explicating the underlying logic of correspondence-oriented memory research and assessment. Thus, an important goal of the target article is to provide a first step toward filling that gap. This, then, should explain our asymmetric treatment of the two metaphors, which was also noted, rather approvingly, by **Ben-Ze'ev:** "K&G characterize themselves as metaphorical pluralists, but their sympathy to the alternative metaphor is obvious - and I believe rightly so."

R1.3. Regarding various types of memories. A third basic objection among some commentators is that the correspondence metaphor is not a suitable metaphor for all types of memory phenomena. For instance, both **Alterman** and **Karn & Zelinsky** argue that the correspondence metaphor is not well suited to capture memory phenomena that fall under the rubric of implicit or procedural memory (Schacter 1987; Tulving 1985). In a similar vein, **McNamara** complains that our taxonomy left out priming phenomena and measures of processing time.

We do not believe that one or two metaphors can possibly capture the entire repertoire of memory phenomena and processes. Clearly, many phenomena fall outside the "focus of convenience" (sect. 6.1) of both the storehouse and correspondence metaphors. What we have tried to do is carve out that aspect of memory involving the explicit recollection of past states and events and to show how the study of such phenomena can be enhanced by an explication of the correspondence metaphor. A large amount of both everyday and traditional laboratory research is certainly devoted to the study of explicit episodic and semantic memories. Thus, although it is worth considering how other aspects of memory might be conceptualized (see sect. R7), we do not think that their omission detracts from the value of our proposal.

R2. Value of the correspondence/storehouse distinction for understanding the real-life/laboratory controversy

As pointed out in the target article (sect. 1), most previous discussions of the everyday/laboratory controversy have revolved around three dimensions of the controversy, what we called the "what" (substantive questions), "where" (context of inquiry), and "how" (methodology) issues. In our analysis, we attempted to show that beyond (or perhaps beneath) these issues lies a more fundamental distinction between two different ways of thinking about memory — the correspondence and storehouse conceptions.

The reactions to this analysis were mixed. On the one hand, many of the commentators indicated, either explicitly or implicitly, that they found the analysis in terms of metaphors useful for their conception of the controversy. Thus, **Fisher** states that our analysis "elevates the laboratory-everyday memory debate to a higher plane than we have seen in recent years." **Larsen** also believes that our discussion of memory metaphors "is timely and potentially very useful, considering that the controversy over naturalistic versus laboratory approaches has partly stymied theoretical development in this area for more than a decade." **Newby** & **Ross** maintain that our analysis "offers the promise of theoretical and empirical advancement, as well as a rapprochement between the two traditions." Finally, **Neisser** believes that the distinction in terms of metaphors "makes it possible to see the dispute between 'ecological' and 'traditional' approaches to memory in a new and clearer light." Neisser, however, believes that a somewhat different

conceptual distinction - between a storehouse and an "action" metaphor - underlies the traditional and everyday approaches, respectively (see sect. R7).

On the other hand, several other commentators expressed reservations about the applicability of our analysis to the real-life/laboratory controversy. First, as mentioned earlier, some **(Bruce, Kvavilashvili** & **Ellis)** believe that the controversy is over and there is no sense in reviving it. They point out that the prevailing state of memory research indicates "a far broader mix of problems, methods, variables, and theoretical orientations than the comparatively narrow study of memory that marked the first one hundred or so years of our science" (Bruce), and hence, "any tension between the two approaches is being gradually resolved in favour of peaceful coexistence and mutual benefit" (Kvavilashvili & Ellis). We certainly hope that this is true. Although we see no harm in "provoking a fresh debate" (Kvavilashvili & Ellis) along what we think are clearer and more fundamental lines, as mentioned before, our primary purpose is to learn from the debate, not to revive it or to explain it.

Second, some commentators have preferred to maintain allegiance to one or more of the "what," "where," and "how" dimensions. **Wright,** for instance, claims that it is the "how" dimension that is at the core of the controversy (cf. Banaji & Crowder 1989), construing this dimension in terms of the contrast between experimental and correlational methodologies. According to him, the choice of methodology ("how") is often dictated by the "where" - laboratory versus real life. However, his characterization of naturalistic research as one in which the experimenter "cannot assign subjects to groups at random" would probably offend most proponents of naturalistic memory research, who argue their case out of strength, not out of weakness. **Bruce,** in contrast, asserts that, if anything, only the "what" issue is germane to the conflict, and that the "what" is motivated by the "where." Thus, he claims that "recognizing the natural contexts of memory would inevitably lead to a broader array of questions and a wider recognition of significant variables. That was the issue, nothing more, nothing less." It is curious that the "where" dimension, which is typically used to label the controversy, is the one that has received the least emphasis in the commentaries. In fact, **Bjork** & **Wickens** argue that the laboratory/real-world aspect is simply irrelevant, as can be learned from advancements in other sciences (see also **Kvavilashvili & Ellis).** Finally, **Neisser** emphasizes that neither the "where" nor the "how" are essential to the controversy, stating that "although differences of method are often involved, the most fundamental difference - e.g., between my views and those of Banaji and Crowder (1989) - does not concern how research should be controlled or where it should be conducted; it concerns how we think about memory itself."

We believe that the foregoing remarks largely confirm the state of affairs that we described in the target article. There is little agreement about which of the dimensions of the controversy - the what, where, or how - is the most critical, or indeed whether any of them is critical. It is this situation that led us, among other things, to seek a more fundamental distinction in terms of the underlying conception of memory.

A third type of objection, however, concerns the adequacy of our proposed mapping between the correspondence-storehouse distinction and the everyday-laboratory approaches. Despite the positive comments by many of the commentators, others were concerned that the relationship may be too imperfect to be of real value. This point was made most directly by **Winograd.** He states that "clearly, you need not be an everyday memory researcher to study accuracy, although there is an affinity there." He points out that many studies of memory accuracy are conducted in the laboratory, and that many studies focusing on memory quantity are conducted in naturalistic settings. Similarly, **Kruglanski** argues that our remarks regarding the lack of necessary interdependence between the what, where, and how aspects of the controversy should obtain for the relationship with the metaphors as well.

Perhaps the simplest way to argue the case for the correlation between the real-life/laboratory distinction and the accuracy/quantity distinction is to walk the reader through the same trail that we took. The original impetus for our work (see Koriat & Goldsmith 1994) derived from an apparent inconsistency between the findings from a naturalistic study reported by Neisser (1988b) and traditional laboratory findings. Upon further examination, we found the inconsistency to implicate, among other things, a tendency for the two types of research to focus on different memory properties — accuracy and quantity, respectively. This tendency is easy to see: on the one hand, the heightened concern with issues of memory accuracy and distortion in everyday memory research can be illustrated by looking at almost any edited book or conference proceedings. Consider, for instance, several representative titles from the program of the SARMAC conference held in Vancouver in July 1995: "Accuracy and distortion in the recall of autobiographical memory content," "Stability and accuracy of self-perceived memory change: A longitudinal analysis," "False childhood memories: Research applications and theory," "Confidence and accuracy in eyewitness studies: Is the conclusion changing?" On the other hand, leafing through some of the traditional memory textbooks (e.g., Crowder 1976, Gregg 1986), as far as we could determine, the words "accuracy" and "distortion" are not even mentioned!

In our mind, this relationship could not be a mere accident. **Fisher** expresses the idea nicely when he reiterates our belief that "there is a nonarbitrary link between research in everyday memory and the use of an accuracy-oriented approach, that is, there is something inherently compatible about the marriage between everyday memory and the correspondence metaphor." In this regard, we think that perhaps **Neisser** is being more prescriptive than descriptive when he asserts that "doing," rather than correspondence, is the metaphor underlying the everyday memory approach (compare his concluding remarks in Neisser 1988b).

Note that the relationship between the metaphors and the approaches is stronger than **Winograd's** analysis implies, if we replace his focus on naturalistic and laboratory research contexts with our focus on the everyday and traditional research approaches, respectively. It is perhaps unfortunate that the labels applied to the two camps (particularly the term "laboratory") tend to focus attention exclusively on the context of inquiry dimension. We think most would agree that Elizabeth Loftus' s (1979a) work on eyewitness testimony, for instance, or Marcia Johnsons (e.g., Johnson et al. 1993) work on reality monitoring (cf. comment by Conway) are prime examples of "everyday

memory" research, even though such work is carried out within the four walls of a laboratory.

Of course, as we acknowledged (sect. 2.2), the correlation between the metaphors/properties and the everyday and traditional approaches is not perfect. Clearly, output-bound accuracy measures have sometimes been used in traditional memory research (see **Bjork & Wickens),** and quantity-based measures of memory are often used in everyday memory research. However, it is hard to deny that the study of everyday memory phenomena has brought with it an unprecedented interest in memory accuracy compared to the very limited role that accuracy has played in traditional laboratory-based research and theorizing **(Conway** goes as far as to assert that our argument "that laboratory research is essentially concerned with counting [memory] traces . . . is undeniably correct"). Essentially, the attributes of the correspondence metaphor represent our attempt to synthesize what is common to a great deal of accuracy-oriented everyday memory research.

R3. Implications of the correspondence metaphor for memory assessment

As mentioned earlier, one of our major aims in explicating the correspondence metaphor was to clarify its unique logic and its implications for the study and assessment of memory performance. Many of the comments acknowledged the value of this metaphor in bringing to the fore aspects of memory that are not well captured by the storehouse metaphor. **Kruglanski,** for instance, states that the correspondence metaphor focuses research attention on issues that are of "paramount relevance to everyday memory concerns," and affords in addition the development of useful new methodologies for memory research." Both **Bahrick** and **Fisher** emphasize the value of the metaphor for the analytic assessment of memory. **Mazzoni** and **Schwartz** stress the contribution of the metaphor in highlighting the role of metamemory processes. However, these and other commentators also bring out several important issues that can help clarify various facets of the assessment of memory correspondence.

R3.1. **What is the proper criterion?** Perhaps the most basic issue concerns the criterion for assessing correspondence, or, as **Begg** puts it, "what corresponds to what?" Begg points out that, in most real-life situations, we have no way of knowing what really happened, that is, no objective criterion against which the memory report can be assessed (see also **Newby & Ross).** Moreover, many commentators wonder whether in principle memories should be compared to an "objective" criterion defined in terms of external reality **(Algom, Begg, Conway, Kruglanski, Mazzoni, Newby & Ross, Palmer).** They argue that perhaps it is the rememberers initial perception or encoded representation of the actual event that should constitute the proper criterion. The argument made by Newby & Ross is representative:

> Individuals may experience the same event quite differently. . . . Consequently, it is not clear what the test of correspondence should be. Perhaps researchers should evaluate memory against an individual's initial representation of the event, rather than against the supposed objective stimulus. After all, we cannot ask more of memory than that recollections reflect the person's original reality; otherwise, we confuse differences in memory with differences in perception."

Along similar lines, **Conway** distinguishes between accuracy and veridicality: "a memory might be completely accurate in that it corresponds directly and fully to some knowledge structure," though it does not follow that it is veridical, and **Algom** points out that "it is perception alone that substantiates reality."

These remarks pose some challenging issues for correspondence-oriented memory research. It is important to note, however, that these issues are not unique to the assessment of memory correspondence, and in fact pertain to the quantity-based assessment of memory as well: Can one calculate "percent recall" for a free-recall task if the list of items actually presented to the subject is unknown? What if the failure to recall a particular item is due to deficient perceptual processing rather than to deficient "memory?" Conversely, is it possible that the correct recall of a particular item actually constitutes a commission error (i.e., is an "adventitious outcome"; **Palmer)?**

In fact, it is rather conspicuous that such questions are hardly ever raised in the context of traditional, quantity-based memory assessment. Perhaps this is because the problem is circumvented somewhat by the typical presentation of sterile and unambiguous stimulus materials that are devoid of personal meaning under tightly controlled conditions (wasn't that Ebbinghaus's ultimate aspiration?). Hence, an objective description of the input may be assumed to approximate what was actually encoded. The situation is more complicated when it comes to meaningful **(Conway)** naturalistic memory situations, which allow much more room for idiosyncratic variance in the initial encoding of the event. Thus, it would seem that the issue does not so much implicate the correspondence-storehouse distinction as it does the distinction between naturalistic and laboratory research contexts: The potential discrepancy between subjective and objective memory criteria should pose a greater problem in naturalistic research settings regardless of whether a correspondence or a storehouse metaphor is adopted. Even here, though, lacking direct access to subjects' initial representations, the simplest (and certainly most common) way of handling the problem might still be to use the "objective" criterion as the best estimate of the subjects' initial encodings (but see Ross, in press, for some further suggestions).

We should stress, however, that the criterion issue is not just methodological, but metatheoretical, and in fact resembles the one we noted with regard to the treatment of metamemory in memory assessment (see sect. 5.3.2): Should the initial encoding process be considered as part of memory itself, or rather as something that should be controlled for or partialled out in the attempt to assess "true" memory correspondence? If, as is often the case, encoding processes are considered to be an integral part of memory (e.g., Craik & Lockhart 1972; Tulving 1983), then perhaps the "objective" description of the event should in any case be the proper criterion. Of course, it would still be useful to have some way of separating the contributions of the initial encoding and those of the other memory processes. Perhaps some method could be devised like the one we proposed for separating metamemory and retention. Clearly, however, this will be no easy task. In this respect, we take the liberty of adapting **Palmer's** comment somewhat: "As jurors we would care only about correspondence with an external state of affairs, but as students of memory, we care about" *both* the correspondence with an external

state of affairs, *and* "the relationship between past experience and current behavior."

R3.2. The wholistic assessment of correspondence. In section 4.1 we outlined the type of wholistic memory measures that follow uniquely from the correspondence metaphor **(Nelson** objects to the term "unique" in this regard; perhaps we should have said "most naturally"). These measures capture the overall multidimensional fit between a complex memory report and some objective description of an earlier event. This is in contrast to the typical focus on analytic, item-based assessment methods that dominate memory research in both laboratory and naturalistic contexts. Our aim in discussing these measures was not only to promote their development and use, but also to explicate some of their special features, in particular, the fact that they cannot be implemented independent of functional considerations. Indeed, several commentators stressed the functional view of memory even more than we did (see sect. R7). In addition, we emphasized that such wholistic measures must also be tailored to specific memory domains and tasks. **Neisser** provides a good illustration of this point, noting that the global measure he used in one study dealing with hearing the news about the *Challenger* disaster (Neisser & Harsch 1992) had to be modified for use in another study dealing with hearing about an earthquake (Neisser et al., in press).

Neisser's example, together with the various criterion issues considered earlier, reinforces our discussion of the problems involved in deriving wholistic correspondence measures, and in fact Neisser observes that "in some cases the assessment of correspondence and accuracy is so difficult that no resolution is possible." We hope, however, that these difficulties will not deter researchers from accepting the challenge of developing such measures. Indeed, we were encouraged by **Kruglanski's** endorsement of our belief in the potential benefits of importing novel measurement techniques from the domain of social perception.

R3.3. Evaluating correspondence on continuous dimensions. Most contemporary memory research is conducted using what we called "analytic" assessment procedures. Among these, the evaluation of dimensional accuracy provides an interesting case: Although it is much more common in both laboratory and naturalistic research than the wholistic approach, researchers generally fail to realize that it too reflects a correspondence rather than a storehouse metaphor.

The implicit use of a correspondence metaphor in dimensional assessment is nicely illustrated by "memory psychophysics" (Algom 1992). Just as traditional psychophysical scaling methods are designed to determine the mapping between physical stimulus dimensions and their perceptual correlates, memory psychophysics investigates the mapping between physical stimulus dimensions and their memory representations. Thus, in the target article (sect. 4.2.2.1), we cited Algom et al. (1985), who found that for the particular dimensions studied (height, width, and area of rectangular stimuli), both memory and perceptual representations mapped onto their physical referents by the same type of functional relation - a power transform. In his commentary, however, **Algom** describes a further example of work that he has done on women's memory of labor pain (Algom & Lubel 1994), which he believes eludes treatment in terms of memory correspondence. Algom argues that because of the lack of an objective criterion, or even common units for the physical and remembered stimulus (intrauterine pressure and pain, respectively), correspondence is not at issue. However, we think that his use of the term "correspondence" is overly restrictive (which may also explain his reservations regarding the role of correspondence in the study of perception). In our conceptualization, his work deals precisely with the (rather complex) correspondence between memory and the external world, as well as between memory and perception. We agree, however, with his observation that in those cases in which common units are lacking, it is not possible to speak of "truth" in any meaningful sense. (See also **Palmer,** who suggested that behavioral learning principles might provide a "tool kit" for extending the study of memory correspondence to situations where common units are lacking.

Another innovative example is provided by **Bahrick** (Bahrick et al., in press), who derived both an accuracy-based measure of distortion and a quantity-based measure of memory "loss" in studying people's memory of their high school grades. He points out that computing separate measures for item loss and item distortion is analogous to deriving the constant and variable error components by the method of average error in psychophysics. This approach allowed him to compare the time course of forgetting in the sense of both loss and distortion, and to clarify the relationship between the two. **White** also emphasizes the similarity between memory and perception, and discusses ways in which the measurement of dimensional memory accuracy can be enlightened by principles and techniques from the study of perception.

R3.4. Item-based assessment: Output-bound accuracy versus input-bound quantity. Turning now to the more standard, item-based approach, the central issues raised by many of the commentators concerned the relationship between quantity-based and accuracy-based memory measures, and the adequacy of output-bound accuracy as a measure of memory correspondence.

(A) Why the distinction? As **Fisher** notes, there is often a practical reason for using output-bound memory measures in real-life situations such as eyewitness testimony, because the experimenter cannot possibly enumerate all of the information making up the input (i.e., the witnessed event). Our point, however, is that output-bound accuracy should be of both theoretical and practical interest, not just by "default," but because it captures a unique property of memory. Note that even without an enumeration of the entire input, it is possible to calculate an output-bound *quantity* score that captures the amount of (correct) information provided by the rememberer, and indeed, this is often done in naturalistic research. Such a measure, however, like the more traditional input-bound, free-report quantity measures (e.g., percent recall), misses an important attribute of the memory report - what we have called its dependability, that is, the extent to which each reported item of information can be depended on to be correct. This attribute, which is of great concern in many situations, is captured by the output-bound accuracy measure.

This is an important point that apparently needs clarification. **Nelson** emphasizes that in computational terms, the "sole difference" between the input-bound quantity measure and the output-bound accuracy measure is that the former includes omission errors in the denominator

whereas the latter does not (see also **Bjork & Wickens, Mayes et al.)**- That, of course, is true. However, conceptually, the distinction between the two types of measures could hardly be more substantial. To illustrate, consider the issue of the credibility of child witnesses, which has gained increasing attention in recent years (e.g., Ceci & Bruck 1993). On -the one hand, a fairly robust finding is that children remember less information than adults (e.g., Brown 1979). This finding is certainly relevant if we are concerned that a child witness may not provide as much information as would an adult in a given situation (but see Ornstein et al. 1992). However, it may not be relevant if concern lies in whether or not the court can trust what the child *does* report. That issue relates specifically to output-bound accuracy, which, in contrast to the quantity measure, does not hold the child accountable for what he or she does not assert to be true. Moreover, as we have shown (Koriat & Goldsmith, in press b), the effectiveness of a persons decision to suffer an "omission error" (say "I don't know"), rather than volunteer incorrect information, depends on the effectiveness of his or her monitoring and control processes. Thus, in a sense, the simple computational difference between excluding and including omission errors in the denominator of the memory measure translates into the fundamental theoretical difference between considering and not considering the role of subject control in determining the dependability of the memory report.

(B) Accuracy versus quantity? Of course, this is not to say that output-bound accuracy alone is sufficient to capture the overall quality of a witness' memory or memory report. Several of the commentators were concerned that we had missed the "deep complementarity" (**McNamara**) between quantity and accuracy, pointing out that perfectly accurate testimony (in an output-bound sense) may be virtually worthless if very little information is reported. Thus, McNamara asserts that "at a more global level, accuracy is scaled by quantity: *Ceteris paribus,* who will the jury believe more, . . . the witness who remembers the color of the assailant's shirt but nothing else (low quantity; high [?] accuracy), or the witness who constructs a detailed account of the event, including clothing, setting, the time of day, and so forth (high quantity; high [?] accuracy)?" Likewise, **Bjork & Wickens** took us to imply that omissions are not a serious problem in real-world contexts like witness memory, but argue that "the failure of the witness to remember salient aspects of the criminal episode leads juries to lose confidence in what the witness does report." Similar concerns were expressed by **Kvavilashvili & Ellis,** and by **Begg,** who also reproached us for endowing accuracy with an "aura of virtue" but equating quantity with "bean counting."

Several remarks are in order. First, it is noteworthy that both **McNamara** and **Bjork** & **Wickens** chose to argue their case from the juror' s perspective. What juries believe and why is indeed an interesting and important question (see, e.g., Duggan et al. 1989), but in fact that issue is independent of the one concerning the actual relationship between the amount of information reported by a witness (input-bound quantity) and the dependability of that information (output-bound accuracy). Jurors may believe that there is a positive correlation between these two memory properties (or perhaps they, like some researchers, simply fail to distinguish between them), but whether or not they are right is an empirical question. Certainly quantity and accuracy measures can be dissociated, as our own work has shown (see also **Bahrick, Fisher).**

Second, despite our admitted bias in focusing on the value of the various types of accuracy measures, we thought we were clear in acknowledging that one of the advantages of the item-based approach is that both the quantity and the accuracy of the reported information can be evaluated in the same procedure (sect. 4.2.2.2), and that they should generally be considered in tandem (see also Klatzky & Erdelyi 1985). Indeed, the quantity-accuracy profile (QAP) methodology that we proposed (sect. 5.3.2; see also Koriat & Goldsmith, in press b), allows one to do just that: "Compared to the standard point measures of memory performance, the derivation of quantity-accuracy profiles allows a more global evaluation of potential memory performance in terms of both accuracy and completeness." However, what the proposed QAP methodology does not do is "scale" accuracy by quantity, or vice versa, in deriving a single composite memory score (as does the signal-detection measure d' for forced-recognition memory). Indeed, because each memory property is of interest in its own right, it is advantageous to be able to examine accuracy and quantity separately (see **Bahrick).** Moreover, as pointed out in the target article (sects. 4.1 and 5.3.2), if an overall assessment of performance is desired, functional considerations tied to the specific circumstances of the testimony or the particular theoretical interests of the researcher will need to dictate the relative weight given to each of the two measures.

Third, the relationship between quantity and accuracy is complicated even further by the potential for differences in the level of generality or "grain size" of the memory report (see sect. 5.1). We thank **Small** for pointing out some classical sources on this topic (among others): "As Thucydides and Aristotle implied, the opposition is not simply between the quantity of the memories (storehouse) and their accuracy (correspondence) but within the correspondence metaphor, between what kinds of memories are subject to being remembered with specific details and what kinds are remembered only in a general sense." **Fisher** provides a nice illustration of how this factor may underlie too* some "experimental anomalies" that are created by looking at either accuracy or quantity in isolation. Having failed to find any effect of retention interval on the accuracy of eyewitness testimony in several studies, he rescored the data to take into account possible differences in grain size, and found that "the responses made after long delays were less precise (coarser grain), although equally correct, than those provided after short delays." Thus, Fisher stresses a troubling implication for eyewitness research: "In order to meaningfully compare response accuracy across two experiments, one needs to ensure that the witnesses in both experiments were similar on the dimensions of report option and grain size." Clearly, more methodological and theoretical work is needed to meet the challenges presented by both report option and control over grain size in the study of memory accuracy.

R4. Implications regarding metamemory and memory

In discussing the implications of the correspondence metaphor, we pointed out that subject-controlled metamemory processes play an important role in the strategic regulation

of memory accuracy, particularly in real-life memory situations. Our analysis focused on what **Fisher** correctly points out are "post-ecphoric" processes (Tulving 1983) and leads to what **Winograd** calls "an expanded conception of retrieval" (see also Moscovitch, in press, and Barnes et al., 1995, for similar recent proposals). We tried to show how a more careful consideration of such processes, together with the distinction between memory quantity and memory accuracy, can help resolve some apparent anomalies in the literature and provide new directions for theoretical and methodological development. One such direction is the attempt to distinguish the separate contributions of retention, monitoring, and control to free-report memory performance. There seems to be a general consensus among the commentators about "how rewarding the consideration of retrieval in depth can be and what an enormous task awaits us" (Winograd).

R4.1. **The importance of metacognition.** Our emphasis on the impact that metacognitive processing has on memory performance and its "practical and theoretical importance" is endorsed by **Nelson,** who also points out that metamemory is an important contributor not only in naturalistic memory situations, but in traditional laboratory research as well. No argument there. There is a vast array of metacognitive processes that have been identified and/or studied in the laboratory (see, e.g., Metcalfe & Shimamura 1994; Nelson & Narens 1990; 1994; Schneider & Pressley 1989) and probably many more that are waiting for attention. Indeed, our own research (Koriat 1993; 1995; Koriat & Goldsmith 1994; in press b) has been entirely laboratory-based. Our point is simply that these processes generally operate more freely both in everyday memory situations and in naturalistic research. Therefore, their study is particularly crucial for those interested in understanding the dynamics of real-life remembering.

Indeed, **Fisher** also stresses this point, noting that in contrast to traditional laboratory research, which often does its best to eliminate the contributions of metamemory, in everyday memory research "we often do not have the luxury of eliminating or controlling these nonmemorial factors, and so they become an integral part of the eyewitness recollection process." He, however, considers decision processes such as report option and control over grain size to be "principles of communication and not memory per se." We would be reluctant to adopt the term "communication" for these processes. Although the term is useful in emphasizing their sociopsychological context **(Winograd),** we believe that it misses the intrinsic role that self-directed monitoring and control processes play in determining what one actually believes one remembers. That is, the decisions underlying overt responses, such as "I don't know" or "it happened around six o'clock" (rather than precisely at six), may be made not only for the sake of communicating one's memories to others, but may also constitute covert self-attributions that affect what a person actually "remembers" (see **Begg).**

This idea is brought out nicely by **Newby & Ross,** who draw our attention to an illuminating parallel between the processes of monitoring one's own memory and those involved in monitoring the accuracy of other people's memories. Ross (in press) identified various criteria that people use when judging the validity of their own or other people's memories, including such factors as vividness, presumed memorability of the event, internal consistency, and consensus - whether other people remember the event in the same way. It is easy to see (Newby & Ross give several examples) how such factors could influence both self- and other-attributions of memory accuracy, and in effect determine what one believes to be true.

R4.2. Separating memory and metamemory. Other comments were directed at issues concerning the proposed separation between retention, monitoring, and control. With regard to memory and monitoring, **Mazzoni** brought up some interesting points concerning the need to distinguish between accuracy from the experimenter's viewpoint and accuracy from the subject's viewpoint. She correctly implies that what we have been calling "monitoring effectiveness," that is, the correspondence between one's confidence judgments and the actual correctness of one's answers, is defined from the experimenter's perspective. A person may be highly confident in an incorrect answer, but this may "accurately" reflect the person's memory representation (see Koriat 1995). An important implication of her remarks is that in order to fully understand the effects of poor monitoring from the experimenter's viewpoint (e.g., Koriat & Goldsmith in press b, Experiment 2), experimenters will need to more fully understand the determinants of monitoring and monitoring accuracy from the subject's viewpoint.

Schwartz presents a view very similar to ours (though he may not realize this) regarding both when and how one might try to separate between retention, monitoring, and control. He argues that one's treatment of metamemory should depend on whether one is interested in developing functional models or structural/process models of memory. Whereas the development of functional explanations of everyday remembering dictates that metamemory processes be allowed to operate freely, in developing structural or process models it is crucial to distinguish between the various memory and metamemory components, because each can affect memory in different ways. The approach that he proposes to separate the components is essentially the one that we have utilized in our own research — to study one component while holding the others constant (see Koriat & Goldsmith, in press b). Of course, we should emphasize that in the context of such a research strategy, holding metamemory constant (e.g., by using forced-report procedures) is not the same as ignoring the effects of subject-controlled processes (see also **Nelson's** endorsement of the need to make metamemory explicit in the assessment of memory performance).

R4.3. Methodological problems: Subject control and output-bound accuracy. Two of the commentaries raised methodological objections that may be seen to involve the relationship between metamemory processes and the distinction between input-bound and output-bound memory measures (see related discussion in sect. R3.4.A). We will consider each in turn. **Bjork & Wickens** argue that because the output-bound accuracy measure is a conditional statistic, based only on those items for which the subject decides to volunteer an answer, it is subject to "the complex and confusing selection artifacts that have always bedeviled such measures." Specifically, they point out that output-bound accuracy might sometimes be "higher for poor study conditions, more difficult materials, and less alert subjects." For instance, a distracted subject might choose to report

only the few items that were so salient (perhaps idiosyncratically) that they couldn't be forgotten, whereas a more alert subject might report many more items, but demonstrate lower output-bound accuracy. Bjork & Wickens ask, can we really say that the former subject's memory is more "accurate?"

Bjork &-Wickens note that the problem they raise has plagued free-report memory assessment for many years, and indeed, it is this very problem that makes the signal-detection methodology inapplicable to free-report situations (Lockhart & Murdock 1970). Why does item selection pose a problem for researchers employing the signal-detection methodology, and for Bjork & Wickens? Essentially, it is because these researchers (see also **Mayes et al.,** discussed below) are interested in measuring memory "accuracy" in an *input-bound* sense, that is, how well the subject's memory reproduces the entire input list (or event). Allowing the subject to choose which items to answer, and looking only at the correctness of those answers, means that the set of items on which the (output-bound) percentage is based may not be a representative sample of the input. Clearly this won't do for a useful input-bound measure.

However, at the risk of repetition, when the research focus is on output-bound accuracy, then (1) one is interested in the dependability of the information that is reported, rather than in the amount of recovered information, and (2) it is subject control in selecting which items to answer (i.e., the option of free report) that operationally distinguishes the former property from the latter (sect. 4.2.2.2). Thus, the concern with output-bound accuracy implies a concern precisely with the products of subject control, that is, with the selection effects themselves (see sect. R3.4.A).

From this perspective, the examples pointed out by **Bjork & Wickens** illustrate the conceptual distinction between input-bound and output-bound measures of memory performance and their relationship to metamemory processes. Suppose that we were to focus on one particular item of information volunteered by both their alert and distracted subjects. Whose statement should we trust more? Probably that of the distracted subject, even though he or she reported fewer items overall. The fact is, each of the distracted subject's statements is more likely to be correct than each of the alert subject's statements, given the difference in output-bound accuracy.

Indeed, to the extent that such dissociations between quantity and accuracy are reliable, they call for a detailed analysis of the separate contributions of retention, monitoring, and control to memory performance. Under what circumstances will dissociations emerge? Could more difficult tests, poorer viewing conditions, and so forth impair overall retention (or encoding), but at the same time yield a more polarized monitoring distribution (i.e., either you know it, or you don't; either you saw it, or you didn't, etc.)? If so, better monitoring resolution could lead to superior, or at least equivalent, output-bound accuracy despite the poorer retention (see the comparison of recall and recognition performance in Koriat & Goldsmith in press b, Experiment 1). Similarly, as **Bjork & Wickens** imply, the word "pumpkin" might be remembered with high confidence and have a high probability of being volunteered, even under superficial encoding conditions or by an inattentive subject, simply because the subject's metamemory is operating effectively ("I'm sure I remember 'pumpkin,' because that's what I call my girlfriend").

We agree that there may be better ways of assessing memory for those interested purely in input-bound quantity/accuracy, for instance, eliminating the selection problem by using a forced-report procedure, as **Bjork & Wickens** suggest. However, for those interested in evaluating output-bound accuracy and understanding its underlying mechanisms, that would be like throwing out the baby with the bath water. Moreover, such an approach would exclude some of the important dynamics underlying memory performance in real-life situations, such as eyewitness testimony. In this regard, Bjork & Wickens maintain that "courtroom testimony is seldom free report. Witnesses are rarely permitted to give narrative answers and are often forced to answer questions." We think that this is a bit overstated. Regardless of whether the witness responds in a free-narrative style or answers specific questions (which is a test-format variable), he or she is always allowed to say "I don't know/remember" if he or she actually doesn't know or remember. That is, report option is always "free." Of course, as Bjork & Wickens point out, there are often both implicit and explicit pressures to supply answers in courtroom testimony (as well as in other memory situations), and these may act to lower the witness' response criterion. However, the way in which witnesses will accommodate these and other demands into their control policy will probably depend on social, functional, and metamemorial factors (e.g., possible age differences in subject control; see Moston 1987), all of which we believe deserve further study.

We now turn to the commentary by **Mayes et al.,** who analyze the item-based quantity and accuracy measures that we discuss from the standpoint of signal-detection theory (SDT). We believe that their analysis is somewhat misguided, mainly because it assumes that we too are motivated by the traditional (signal-detection) desire to achieve a single global measure of (input-bound) memory accuracy. Thus, they argue that our accuracy measure, which ignores omissions, is not a good measure of memory correspondence. What is needed, they say, is an overall correspondence measure that takes both omission errors and false alarms into account: "SDT provides such a measure for recognition, but not for recall, as K&G argue. Our contention is that neither does their accuracy measure; nor at present, does any other recall measure."

Of course they are quite right. As discussed earlier (sect. R3.4.B), neither the output-bound accuracy measure nor the input-bound quantity measure alone can fill that job (but see our discussion of wholistic correspondence measures in sect. 4.1). In tandem, however, they do allow the researcher to focus on two important properties of memory in free-report situations: its quantity and the extent to which it can be depended on to be correct. As interesting as **Mayes** et **al.'s** analysis is, it seems to miss the point that in addition to posing some methodological limitations, free-report memory situations also endow a different *meaning* to many of the concepts used in signal-detection analyses of forced-recognition performance. For instance, it is simply inappropriate to apply free-report accuracy and quantity measures to the old/new (yes/no) recognition paradigm, as Mayes et al. have done, because by doing so, these measures lose their intended interpretations (see note 14 in the target article). Thus, the free-report quantity measure is not

equivalent to the hit rate (which can be arbitrarily raised to any desired level), and the free-report accuracy measure is not equivalent to hits/(hits + false alarms), because this latter proportion does not depend on the subjects actual commitment to the correctness of his or her answers.

Finally, **Mayes et al.'s** use of the term "monitoring" is also different from ours. Although they assert that for us, "monitoring is discrimination between target and foil items," this in fact appears to be their use of the term, and in keeping with the signal-detection approach, they expect that monitoring should provide the basis for good quantity performance. We, however - borrowing from the metacognitive judgment literature — treat monitoring as the subject's ability to discriminate between correct and incorrect answers, that is, which items he/she can answer correctly and which he/she cannot. This distinction is a subtle one, and we thank Mayes et al. for helping us clarify it. As these researchers discuss, monitoring (as they use the term) may be involved in arriving at a best candidate answer for a particular question (i.e., by eliminating the myriad of alternative possible responses), but once that best candidate is chosen, monitoring (as we use the term) also determines one's confidence that the answer is correct and contributes to the decision whether to provide the answer or to abstain. Mayes et al. correctly point out that in recall testing we cannot evaluate subjects' monitoring effectiveness in the first sense. However, we can in the second sense, by computing the correlation between confidence and correctness across items under forced-recall instructions (see Koriat & Goldsmith, in press b).

R5. Implications for memory theory

Although the implications of the correspondence metaphor are perhaps most salient with regard to the way in which memory is assessed, the focus on memory correspondence should also influence memory theorizing. Indeed, we argued (sect. 3) that many contemporary approaches to memory seem to reflect an implicit shift toward a correspondence-oriented conception. However, the dividing line between the correspondence and storehouse approaches may be quite fuzzy. Thus, for instance, **McNamara** points out that theories such as ACT* (Anderson 1983), SAM (Gillund & Shiffrin 1984), and TODAM (Murdock 1982) have incorporated much more sophisticated schemes of representation and processing than earlier models. One might wonder, then, whether the metaphorical contrast we proposed is in fact useful in the realm of memory theory. This calls for a point of clarification regarding two concepts - "storage" and "representation." The notion of "storage" in its broadest sense is so basic to our thinking about memory that it is very difficult to eliminate it altogether from our theorizing. Thus, most theories posit either implicitly or explicitly that information must somehow be held between exposure and test. (An interesting exception that proves the rule is **White's** characterization of "direct" memory, in which memory is conceived almost literally as the perception of the past; see also Watkins 1990 and sect. 3 of the target article.) The form in which the information is held, however, is a matter of dispute. **Ben-Ze'ev,** for instance, distinguishes between "storing" and "retaining," the former implied by a "container approach to the mind," and the latter implied by a view of memory as a "disposition" or "capacity" (e.g., for Correspondence) that has the potential to be actualized. He argues for the latter view. **Kruglanski,** on the other hand, believes that storage constitutes part of the "critical nucleus" of memory, whether or not it is conceived as a "specific and discrete recording of an event," or "diffuse and widespread modifications of the whole cognitive system (Craik 1983)."

The important point to note is that the incorporation of some notion of storage or retention does not imply subscription to the storehouse metaphor, at least not in the sense that we emphasized. What we took as the distinctive feature of a storehouse view is the way in which the "stored" information is treated: as a set of items ("ideas," "images," "records") that can be counted. This characteristic, a hallmark of the influential verbal-learning tradition, allows memory to be evaluated by a simple count of the number of items remembered after a retention interval. Of course, one may conceive of memory as a store of ideas, as Locke did, or as a store of images, and be concerned instead with the extent to which these ideas or images conform to reality. This kind of treatment would then imply a *correspondence* metaphor. It is in this sense that **Ben-Ze'ev** asserts that the correspondence and storehouse conceptions are not mutually exclusive, and we agree. In fact, our own work within the item-based approach is perhaps a good example.

A somewhat similar distinction can be applied to "representation." As **Conway** correctly notes (and see **McNamara),** the concept of representation is one of the cornerstones of the cognitive approach to memory. The virtue of representational models is that they must address some qualitative aspects of memory, notably the content of what is retained. The way in which that content is treated in presenting and testing the model, however, is another matter. The use of a representational model implies a correspondence view only insofar as the memory representations are in fact treated as descriptions of, or as being "about" past events, and the model is then evaluated accordingly. Thus, as McNamara protests, many contemporary theories incorporating sophisticated representational schemes "are founded on and evaluated against data produced by quantity-oriented research, such as learning lists of words or sentences." Indeed. But have these models also been tested to see how well they capture data pertaining to the *correspondence* between people's memory reports and past events?

We believe that making the correspondence metaphor explicit can help lead to theories and models that are specifically correspondence oriented. By this, we mean, among other things, models that are designed to explain both how memory correspondence is achieved and why it can go wrong. We admit that the correspondence metaphor, unlike the storehouse metaphor, does not in itself provide any guidance about what such a theory should look like (but see the discussion of correspondence-type metaphors in sect. R6.3). Thus, a correspondence-oriented model based on a reconstructive view (cf. **Larsen),** might look very different than a model based on a "direct" Gibsonian view of memory (cf. **White).** However, as mentioned earlier, we disagree with **Schwartz's** contention (see also **Kruglanski)** that the correspondence metaphor is suitable for functional models only. The correspondence metaphor can and should also generate structural or process models (and we include here connectionist models) that focus on the memory — and metamemory — mecha-

nisms underlying memory accuracy and distortion (e.g., Koriat & Goldsmith, in press b; Metcalfe 1990; Wagenaar & Boer 1987).

R6. Regarding the metaphors

We now turn to issues concerning the metaphors themselves. One general conclusion is quite clear from the commentaries: researchers take metaphors seriously! Aside from the many comments directed to the correspondence metaphor, concerning both its advantages and its limitations for guiding the study of memory, there were also advocates (as well as critics) of the storehouse metaphor and of several other proposed metaphors. Two notable exceptions to the general debate are the commentaries of **Bruce** and **McNamara,** both of whom gave arguments to the effect that "memory research moves in directions that are independent of abstract background metaphors" (Bruce).

R6.1. **Metaphorical pluralism.** A general theme that runs throughout the commentaries is the need for metaphorical pluralism (but see **Bruce,** who believes that "reasonable as that call is, it is unlikely to lift the audience to its feet"). As mentioned earlier (sect. R1.2), this view is implied by many of the commentators who argue for the value of both the correspondence and the storehouse metaphors. **Nelson** was most explicit in emphasizing that "investigators should Use whichever metaphors work best. . . and that in contrast to the substantial achievements in philosophy of science for evaluating theories, no satisfactory method is available for evaluating metaphors and analogies." Similarly, **Neisser** also stresses that there is no point in arguing about metaphors "as if an empirical question were at stake." This view, of course, is precisely what we expressed in the target article (sect. 6.2).

There seems to have been some misunderstanding, however, of our final message regarding the "chariot of science." **McNamara,** for instance, states that he is "moved instead by a different metaphor: when it comes to pulling chariots, two horses are better than one" (see also **Kruglanski).** That, however, is what we thought we had said. In addition, **Nelson** expresses his belief that "progress seems to be less likely if two horses pull in different directions - and directions of pulling that are too different may even be counterproductive and pull apart the metaphorical chariot." Perhaps we should have used a different meta-metaphor. Our belief is that science will be best served if each metaphor is exploited to its fullest. Thus, our admonition is to avoid *compromising* the particular advantages of each metaphor, not to avoid constructive cooperation.

R6.2. Is correspondence a metaphor? One point that was brought up by several commentators is that correspondence is not actually a metaphor. **Ben-Ze'ev** notes that, unlike the storehouse metaphor, correspondence is not a metaphor about what memory is. **Neisser** states that correspondence is better thought of as a goal or criterion. Finally, **Larsen** asserts that the notion of correspondence "does not confer any surplus meaning from its source domain to the understanding of memory, and it does not suggest any further properties of the memory system. Rather, it identifies a core feature to be included in an alternative metaphor."

We have characterized the correspondence metaphor as an "abstract" memory metaphor. We think that correspondence, as an abstract concept, can be applied to memory in a metaphorical as well as in a literal sense. Take, by analogy, the "activity" metaphor suggested by several commentators **(Alterman, Karn & Zelinsky, Neisser;** see sect. R7). On the one hand, at least some instances of remembering can be characterized as (cognitive) activity in a literal sense. At the same time, however, by considering other lands of activity, activity as a metaphor (or analogy) may indeed confer surplus meaning from its source domain(s) to the understanding of memory. The same is true for correspondence: the correspondences between a photograph and its subject, a sculpture and its likeness, a percept and its distal stimulus, a model and its referent, a regression line and its data points, all suggest different ways of thinking about memory — what it is designed to achieve, how it might achieve it, and how it might be evaluated. The concept of "goodness of fit" (sects. 2.2 and 4.1), borrowed from statistical analysis, is one such example.

However, there is not much to gain by belaboring this issue. Whether it is in fact a metaphor, an analogy, or simply a conception, our point is that there are important implications that derive from thinking about memory in terms of its correspondence with past events. Moreover, just as there are many possible variants of the storehouse metaphor (e.g., **Bjork & Wickens),** the correspondence metaphor also denotes a class or *type* of memory metaphor, in which (as pointed out by **Larsen)** correspondence is a "core feature" (as well as some of the other interrelated features that we specified in sect. 2.2). These more concrete instantiations will generally provide more specific constraints and guidance for the ensuing research and theorizing, as we now consider.

R6.3. Correspondence-type metaphors. A useful illustration of a more concrete correspondence-type metaphor is **Larsen's** "archaeology" metaphor. As he notes, that metaphor assumes a reconstructive approach to memory (Bartlett 1932), and is similar to the "paleontology" metaphor used by Neisser (1967). Larsen stresses that the archaeology metaphor

> suggests a conception of memory that is remarkably close to Koriat and Goldsmiths correspondence view (cf. sect. 2.2) yet does not ignore that traces from the past are indeed stored somehow. To achieve correspondence between a present account and past reality is precisely the overarching aim of archaeology. Like in memory, collecting items from the past only serves the purpose of constructing true descriptions to represent the past.

It is interesting that **Neisser's** current comments point out that memory construction need not serve only the goal of achieving correspondence, so that while the construction metaphor "still makes sense" to him, he apparently no longer endorses a paleontology metaphor. Be that as it may (see further discussion in sect. R7), metaphors such as archaeology or paleontology are indeed good instantiations of a correspondence-type metaphor. Thus, we (and Larsen) disagree with **Ben-Ze'ev** when he asserts that the correspondence metaphor is incompatible with the reconstructive approach. His argument seems to be aimed against a passive, "copy" type of correspondence metaphor.

Many other types of correspondence metaphors may also be envisaged (e.g., "resonance," "holography," "stage-setting"; see note 5 of the target article). In fact, the notion

of memory as "perception of the past" is itself a correspondence metaphor, which can be fleshed out further depending on one's particular view of perception. Thus, for instance, the "paleontology" metaphor was proposed by Neisser (1967) as a useful metaphor for capturing both perception and memory. **White,** on the other hand, viewing memory and perception quite differently than Neisser did in 1967, outlines a more "direct" correspondence view in terms of a theory of direct remembering (TDR) (White 1991), following Gibson's (1979) view of perception: "In TDR, memory and perception are continuous and the same discrimination principles apply to both. Environmental information at the time of retrieval allows direct perception of the remembered event. The event is not stored but perceived directly, albeit at a temporal distance." Finally, according to **Kruglanski,** who is perhaps reading in some aspects of social perception, the correspondence metaphor treats memory as a "judgment" about past events, though he argues that a judgment metaphor of memory must be supplemented by some type of storage conception.

In sum, we have chosen to present an abstract correspondence metaphor, rather than a particular version, because our primary concern is in explicating the general logic of the correspondence conception, not in putting forward a specific view of memory correspondence. Clearly, however, this metaphor can submit to a variety of instantiations depending on the researcher's particular metatheoretical convictions.

R7. Beyond the correspondence metaphor: The myriad facets and functions of memory

Perhaps one of the most salient features of memory is its multitude of facets. Thus, as mentioned earlier (sect. R1.3), several commentators highlighted aspects of memory for which neither the correspondence nor the storehouse metaphors seem well suited, and some proposed their own alternative metaphors to capture these aspects. Common to all of these discussions is some assumption about the basic function of memory in subserving adaptive interaction in everyday life.

Both **Alterman** and **Karn & Zelinsky** emphasize the function of memory in supporting a variety of activities and procedural skills that constitute the major portion of our daily interaction with the environment. For instance, **Alterman** stresses the "pragmatic" aspects of memory in such activities as operating a photocopy machine. Similarly, **Karn & Zelinsky** point out that "memory is most often used, without conscious awareness, in natural tasks such as driving, walking, grasping, speaking, and problem solving," and emphasize "the active role that memory plays in goal-directed behavior." These commentators argue that correspondence or accuracy is not at issue for such activities. This argument would seem to hold for the entire domain of implicit or procedural memory (Schacter 1987; Tulving 1985), in which memory is not really "about" anything (Tulving 1985), and so issues of truth and accuracy are simply inapplicable (can someone accurately or truthfully ride a bicycle, operate a copy machine, or solve an anagram?). Perhaps the correspondence metaphor could be stretched to cover such phenomena, for instance, by considering the correspondence between an organism's current behavior and experienced contingencies in the environment, or between its behavior at one point in time and another **(Palmer).** It might be more fruitful, however, simply to seek another metaphor that is better suited to capture such phenomena. **Eichenbaum** reaches a similar conclusion based on the parallel between implicit versus explicit memory in humans and "stimulus-response" versus "cognitive" memory in animals. He argues that the correspondence metaphor is well suited to capture explicit/"cognitive" memory phenomena in both domains, but may be less useful for implicit/stimulus-response type phenomena.

In contrast to these commentators, however, **Neisser** and **Winograd,** while also emphasizing the functional-behavioral aspects of memory, seem to ground their functional perspective in a humanistic-social view of man, focussing on more explicit and controlled forms of remembering. For **Neisser,** "remembering is a land of doing. Like other kinds of doing, it is purposive, personal, and particular." This view is also shared by **Winograd,** who stresses the social function of remembering. Both Neisser and Winograd emphasize that memory-based behaviors, such as joke or story telling, or even sharing personal memories, may have other goals apart from accurate reproduction, such as entertaining or impressing others. The personal and social goals that they emphasize (e.g., impression management) are not unique to "remembering," but are subserved by other behaviors as well (compare **Kruglanski's** concern that the correspondence metaphor may leave out aspects of cognitive activity that are unique to "memory"). Likewise, according to **Anderson,** "the function of memory is to make past experience useful in pursuit of present goals." More specifically, "the typical goal involves value judgments: approach-avoid, good-bad, etc." His view also emphasizes operations, valuation, and integration, which are "fundamental to function in general and to memory in specific."

We are pleased that our article has stimulated a critical discussion of the function of memory in everyday life, and are sympathetic to the concerns brought out in these comments. Like these other proposals, the correspondence metaphor is also motivated by an important function of memory in everyday life: that of providing a faithful representation of past events. Thus, we emphasized that in this conception, "memory does not serve merely as a depository of isolated, lifeless units, but rather affords a meaningful representation of real-life events that can be effectively utilized in future interactions" (sect. 2.2). We also stressed that for this very reason, the evaluation of memory correspondence must also take functional considerations into account in weighting the different aspects or dimensions of correspondence (e.g., accuracy vs. quantity, gist vs. detail; central vs. peripheral information; see sects. 4.1 and 5.3.2).

Of course, we agree that 0memory in real life serves functions other than that of providing accurate information about the past. In fact, it is rarely the case that accurate reproduction (or correspondence) is a goal in itself. Even in the most artificial of laboratory experiments (cf. **Winograd),** accurate remembering is probably subordinate to other goals, such as maintaining one's self-esteem, impressing the experimenter, and so forth. How much more so in natural situations! Nevertheless, even if we consider such everyday goals as impression management **(Neisser,** Winograd) or attitude formation **(Anderson),** we think it is clear that such goals will also generally be served by having available an accurate representation of the past, whether or

not that representation is put to use. (Consider also the importance that people attach to the validation of their own and other peoples memories; **Begg, Newby & Ross.)** Thus, unlike Neisser and Winograd, who cast correspondence (verity) and utility as two ends of a continuum (emphasizing situations in which they diverge), we see correspondence as generally, though not always, subservient to utility.

In sum, memory is not monolithic, and any attempt to characterize it in terms of a single quality or function will certainly not do justice to its inherent heterogeneity (cf. **Anderson's** claim that "this [valuation and integration] is what memory is for"). Indeed, any single metaphor, correspondence included, is likely to capture but a limited part of memory's full nature. Hence, in order to encompass the many facets of memory, we hope that much more versatility will be seen in the use of memory metaphors and in developing their ensuing research orientations than has been witnessed in the first hundred years or so of memory research.

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