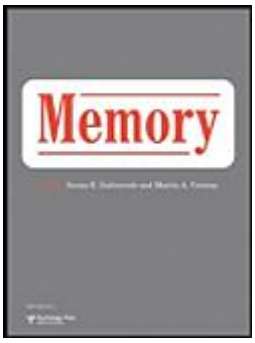

Object categorisation, object naming, and viewpoint-independence in visual remembering: Evidence from young childrens' drawings of a novel object.

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Running head: **OBJECT CATEGORISATION AND VISUAL MEMORY**

Object Categorisation, Object Naming, and Viewpoint-Independence in Visual Remembering: Evidence From Young Childrens' Drawings of a Novel Object

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Abstract

A simple object drawing task confirms a three-way association between object categorisation, viewpoint-independence, and longer-term visual remembering. Young children (5- to 7-year-olds) drew a familiar object, or a novel object, immediately it had been hidden from view, or on the following day. Both objects were shown from a full range of viewpoints, or from just two viewpoints, from neither of which would either object normally be drawn after unrestricted viewing. When drawing from short-term memory after restricted viewing, both objects were most likely to be depicted from a seen viewpoint. When drawing from longer-term memory after restricted viewing, the novel object continued to be drawn from a seen viewpoint, but the mug was now most likely to be drawn from a preferred viewpoint from which it had not been seen. Naming the novel object with a novel count noun ("Look at this. This is a dax"), to signal that it belonged to an object category, resulted in it being drawn in the same way as the familiar object. The results concur with other evidence indicating that short-term and longer-term visual remembering are differentially associated with viewpoint-dependent representations of individual objects and viewpoint-independent representations of object categories, respectively.

Object Categorisation, Object Naming, and Viewpoint-Independence in Visual Remembering: Evidence From Young Childrens' Drawings of a Novel Object

Evidence is accumulating to suggest that short-term and longer-term visual remembering can rely on representations that preserve contrasting information about objects. For example, compared to short-term remembering, longer-term remembering is more likely to reflect visual information about object categories than about specific objects (Avons & Phillips, 1987; Burgund & Marsolek, 2000; Marsolek, 1995), and information that specifies object shape categorically rather than with metric accuracy (Rosielle & Cooper, 2001). It is less likely to reflect either the specific viewpoint(s) from which objects were originally seen[1] (Biederman & Cooper, 1991, 1992; Biederman & Gerhardstein, 1993; Cooper, 1994; Cooper & Schacter, 1992; Ellis, Allport, Humphreys, & Collis, 1989; Seamon & Delgado, 1999; Seamon, Ganor-Stern et al., 1997; Stankiewicz et al., 1998; Stankiewicz & Hummel, 2002), or the colours of objects (Brandimonte, Schooler, & Gabbino, 1997; Cooper, 1994; Hitch, Brandimonte, & Walker, 1995; Seamon et al., 1997; Walker et al., 1997).

These contrasting aspects of objects, that are differentially associated with short-term and longer-term remembering, might be preserved in two distinct types of visual representation. Candidate representations are images, such as those proposed by Tarr (e.g., Tarr, 1995), and structural descriptions, such as the geon structural descriptions (GSDs) proposed by Biederman (e.g., Biederman, 1995). Images are object-specific, preserve information about the object's orientation in depth relative to the viewer, and are likely to capture all the visible features of an object (e.g., its surface colour). In contrast, GSDs represent object categories at an intermediate level of abstraction, and focus on the shape of category relevant object parts in their spatial configuration, to the exclusion of information about an object's material properties (including colour). With shape being encoded

categorically, rather than with metric accuracy, GSDs are tolerant to the variation in shape among exemplars from a category. They are also largely insensitive to orientation in depth, and so can represent object categories in a way that is viewpoint-independent. Perhaps, therefore, it is because these two forms of representation are differentially associated with short-term and longer-term remembering, that information about contrasting aspects of objects has varying relevance depending on memory delay. The proposal is not that short-term and longer-term remembering are exclusively dependent on different types of representation, but rather that, though both types of representation can support visual remembering in most situations, there is a tendency for short-term remembering to rely on image-like representations, and longer-term remembering to rely on GSD-like structural descriptions when these are available.

If the various features of objects reflected in longer-term visual remembering are preserved in a single representation, then their impact on performance should be highly correlated. For example, when participants appear to rely on visual category representations in longer-term remembering, their performance should also confirm the viewpoint-independence of these representations. Conversely, when participants are deprived of the opportunity to rely on category representations, longer-term remembering should reveal the same sensitivity to viewpoint that is observed in short-term remembering, because in both situations viewpoint-dependent object representations will mediate performance.

The two experiments reported here were undertaken as part of a project examining intellectual realism in young children's drawings (cf. Walker et al., 2006). As a source of information about the cognitive resources supporting drawing, young children offer the advantage that they are relatively unconstrained by culturally-determined drawing conventions, and their drawings are susceptible to a range of variables. The first experiment

examines the three-way association between object categorisation, viewpoint-independence, and longer-term remembering. Based on the understanding that naming a novel object with a novel count noun can establish a category representation for the object, the second experiment provides converging evidence for the role of object categorisation by examining the three-way association between object naming. viewpoint-independence, and longer-term remembering.

Experiment 1

Experiment 1 asks if the availability of a visual object category representation will increase the viewpoint-independence evident in drawings based on longer-term remembering. Young children completed a simple drawing task in which they drew either a novel object or a familiar object, under short-term or longer-term memory conditions. The novel object comprised a cube with a cone attached to the centre of one face. The familiar object was a drinking mug. Prior to drawing, the objects were presented for inspection, either from a full range of viewpoints, or from a single viewpoint from which the cone/handle pointed to the left from the child's vantage point. This viewpoint was chosen because it is not one from which either object is normally drawn from memory after unrestricted viewing. Thus, drinking mugs are normally drawn from memory with their handle pointing to the drawer's right. The novel object is normally drawn either with the cone pointing to the drawer's right, or with the cone pointing upwards (Walker et al., 2006). After being presented for inspection, the objects were placed so that the cone/handle could not be seen (i.e., with the cone/handle pointing directly away from the child). Neither object was named by the experimenter during the experiment.

Viewpoint-dependent object representations preserve information about objects only in relation to the viewpoints from which they have been seen. Drawings based on these

representations should, therefore, be most likely to depict an object from a viewpoint from which it has been seen. Because geon-like structural descriptions of object categories are largely invariant to viewpoint, drawings based on these need not be constrained by viewpoint in this way, allowing the drawer to depict an object from a viewpoint from which it has not been seen. Given the presumed viewpoint-invariance of visual category representations, it was predicted that when the objects were seen from just the two viewpoints used in the restricted viewing conditions, the presence of an established category representation for the mug would increase the likelihood of it being depicted from a different (unseen) viewpoint. In addition, given the presumed association between category representations and longer-term remembering, it was predicted that the effect of object familiarity would only be observed with longer-term remembering. Object familiarity was not expected to have an effect when the objects were seen from a full range of viewpoints prior to drawing, or when they were drawn from short-term memory. Put differently, memory delay[2] was expected to impact on drawing only when the familiar object was presented from a restricted set of viewpoints.

Method

Participants

One hundred and sixty 5- to 7-year-olds participated in Experiment 1 (mean age = 6 years 4 months; age range = 5 years 0 months to 7 years 11 months).

Materials

The familiar object was a plain white cylindrical mug, 12 cm high, with a base radius of 6 cm. The novel object was made from wood, and comprised a 12 cm cube with a cone attached to the centre of one face. The cone had a base radius of 3 cm, and a height of 8 cm.

This object was smoothed and painted with red gloss paint. Each child was provided with a single sheet of A4 white paper and a pencil with which to draw.

Design

An independent-groups design was created by crossing three factors, each with two levels. The factors were Object Familiarity (*novel object* versus *mug*), Viewing Condition (*restricted viewing* versus *unrestricted viewing*), and Memory Delay (*short-term remembering* versus *longer-term remembering*). An equal number of participants (n = 20) were assigned randomly to each of the eight groups, with the constraint that the groups were matched for age and gender.

Procedure

All the children were tested individually in a quiet section of their classroom, with a table separating them from the experimenter. The same procedure was used regardless of the familiarity of the object to be drawn, and at no point did the experimenter provide a name for either object. For every child, the experimenter started by removing a plain, up-turned cardboard box, positioned in the centre of the table, to reveal the object to be drawn. The object was positioned with its attached part (i.e., the cone or handle) pointing to the left from the child's vantage point. In the *restricted viewing* condition, the experimenter picked up the object and held it in front of the child without changing its orientation. In the *unrestricted viewing* condition, the experimenter picked up the object and proceeded to rotate it, following a carefully rehearsed routine, so that the child was exposed equally to each major facet of the object. While presenting each object to the child, the experimenter said "Look at this object." After presenting the object for 20 s, the experimenter replaced it on the table with the cone/handle now hidden from view, that is, with the cone/handle pointing away from the child. The experimenter then primed the child for the drawing task. In the short-term

remembering condition, she said "Look at this object as it appears to you now, because in a moment I want you to draw it as it appears to you now." She then replaced the up-turned box to hide the object from view, and said "Now, could you draw the object, just as you remember seeing it before I hid it under the box?" In the longer-term remembering condition, the experimenter primed the child by saying "Look at this object as it appears to you now, because tomorrow I want you to draw it as it appears to you now." The box was replaced to hide the object from view. When the child returned the next day, the up-turned box was still on the table and the experimenter said "Now, could you draw the object you saw yesterday, just as you remember seeing it before I hid it under the box?" After completing their drawing, each child printed their name at the top of the paper, and the experimenter noted which hand they had used to draw and write.

An additional aspect of the experiment, of secondary importance, involved asking children in the short-term remembering condition also to return the following day to produce a second drawing of the object. After producing their first drawing, the experimenter told them "Tomorrow, I want you to draw this object again." Thereafter, they were treated in the same way as children in the long-term remembering condition.

Results

In both experiments being reported here, the view from which an object was depicted in each drawing was assessed by a colleague who was ignorant of the purpose of the study and of the conditions under which the drawings had been produced. **She was shown the two objects, and told that each object had been held in a single cardinal orientation directly in front of the drawer. In the case of the mug, it was explained that the possible orientations involved the handle pointing directly to the drawer's left, to their right, directly towards them, or directly away from them (and, therefore, out of view). In the**

case of the novel object, it was explained that the possible orientations involved the cone pointing directly to the drawer's left, to their right, upwards, downwards, directly towards them, or directly away from them. On the basis of the child's depiction, she was asked to decide from which orientation the object had been viewed during drawing. In fact, the viewpoint from which an object was depicted in each drawing was unambiguous, and the first author was entirely in agreement with the judgement of his colleague.

Figure 1 presents the number of drawings in each condition in which each object was depicted from a restricted viewpoint (i.e., from one of the two viewpoints from which the objects were seen in the restricted viewing conditions), as opposed to some other viewpoint.

Analysis of the likelihood of depicting an object from a restricted viewpoint, as opposed to any other viewpoint, confirmed the impact of manipulating the viewing condition. Thus, aggregating across levels of object familiarity and memory delay, there were significantly more drawings in the *restricted viewing* condition, than in the *unrestricted viewing* condition, that depicted the object from one of the restricted viewpoints, *Fisher's Exact* $p = .001$ (except where stated otherwise, all p's reported below relate to *Fisher's Exact Probability* test).

In the *unrestricted viewing* condition, object familiarity had no effect on the likelihood with which an object was depicted from a restricted viewpoint, regardless of memory delay, $p = .73$ and .69, for short-term and longer-term remembering, respectively. However, in the *restricted viewing* condition, the mug was less likely than the novel object to be depicted from a restricted viewpoint, but only with longer-term remembering, $p = .009$, and not with short-term remembering, $p = 1.0$.

In the *unrestricted viewing* condition, Memory Delay did not change the probability with which an object was depicted from one of the restricted viewpoints, $p = 1.0$ and .27, for

the novel object and mug, respectively. However, it did have an effect in the *restricted viewing* condition, but only for the mug. Specifically, whereas delaying the test of memory in the *restricted viewing* condition had no impact on the likelihood with which the novel object was depicted from a restricted viewpoint, $p = .75$, memory delay reduced the likelihood of this in the case of the mug, $p = .001$.

Secondary analysis. Figure 2 presents data from the children in the short-term memory condition, all of whom returned to produce a drawing from long-term memory.

Analysis of the drawings produced from longer-term memory by these children confirmed the results obtained from those children who produced a drawing only from long-term memory. Thus, with regard to the second of the two drawings produced by children in the short-term memory condition, there were significantly more drawings in the *restricted viewing* condition, than in the *unrestricted viewing* condition, that depicted the object from one of the two restricted viewpoints, $p = .023$. In addition, whereas object familiarity had no effect on the viewpoint from which an object was depicted in the *unrestricted viewing* condition, $p = .41$, it did have an effect in the *restricted viewing* condition, $p = .053$, with the mug being less likely than the novel object to be depicted from a restricted viewpoint.

When both drawings produced by this group of children were submitted to a *McNemar Test* for change, a significant change in depicted view with memory delay was observed only for drawings of the mug in the *restricted viewing* condition. Thus, in the *unrestricted viewing* condition, there was no significant change in depicted view with memory delay either for drawings of the novel object, *McNemar* $p = .25$, or for drawings of the mug, *McNemar* $p = .50$. In the *restricted viewing* condition, there was no significant change in depicted view with memory delay for drawings of the novel object, *McNemar* $p = .625$, but there was a significant change for the mug, *McNemar* $p = .004$. Specifically, a

significant majority of the children changed from depicting the mug from a restricted viewpoint in their first drawing, to depicting it from some other viewpoint in their second drawing.

Finally, only four participants drew with their left hand. When handedness and gender were taken into account, neither had a significant impact on the viewpoint from which either object was depicted.

Discussion

When young children drew an object from memory, the extent to which their depictions were constrained by the viewpoints from which the object had been seen was influenced by the object's familiarity, and by whether the object was being drawn from short-term or longer-term memory. Specifically, with the shift from short-term to longer-term remembering, the children became more inclined to depict a familiar object from a (normally preferred) viewpoint from which it had not been seen. The same trend was absent in their drawings of a novel object. This three-way association between object familiarity, viewpoint-independence, and memory delay, was predicted on the basis that distinct types of visual object representation are differentially associated with short-term and longer-term remembering (cf. Introduction). To reiterate, though viewpoint-dependent, image-like representations of objects, and viewpoint-independent, GSD-like structural descriptions of object categories, are normally available to support both short-term and longer-term remembering, there is a tendency for people to utilise the former in short-term remembering and the latter in longer-term remembering. Because GSD-like category representations were available only for the mug, only for this object could the viewpoint-independence of these representations remove the constraints associated with restricted viewing when the children drew from long-term memory. When the children either drew from short-term memory or

drew the novel object, their drawings seem to have been supported by an image-like representation of the object, whose viewpoint-dependence ensured they were constrained to depict the object from a viewpoint from which it had been seen.

Experiment 2

Bozeat et al. (2003), in a study of semantic dementia, have shown that with memory delay drawings can become progressively more dependent on generic visual knowledge, even when the instruction is to draw the particular object the experimenter had shown them. With this in mind, some uncertainty must remain concerning the extent to which depictions of the mug from an unseen viewpoint after restricted viewing in the present study were drawings of a generic mug, rather than drawings of the particular mug shown to them by the experimenter. Uncertainty remains because there was nothing distinctive about the mug that, if reproduced in the drawing, would have confirmed that it was that specific mug that was being drawn. In principle, such uncertainty can be removed by using novel objects as experimental stimuli, especially if a simple and effective way can be found to induce participants to establish a category representation for a novel object on the basis of a single encounter.

Rosch et al. (1976) and Hoffman, Denis, and Ziessler (1983) have demonstrated that common object names are linked most directly to visual representations of object categories at an intermediate level of abstraction (i.e., at the basic-level). The impact of object naming on the creation of category representations confirms this privileged link. Thus, naming a novel object with a novel count noun induces infants and young children to establish a shape-based category representation for the object (Baldwin, 1989; Hall, 1993; Hall & Moore, 1997; Hall, Quantz, & Persoage, 2000; Hall & Waxman, 1993; Landau, 1994; Landau, Smith, & Jones, 1988; 1992; Smith, Jones, & Landau, 1992; Waxman, 1999; Waxman &

Booth, 2001; Waxman & Hall, 1993; Waxman, Philippe, & Branning, 1999; Waxman, Senghas, & Benveniste, 1997) at an intermediate taxonomic level (Hall, 1993; Hall & Waxman, 1993; Waxman, 1999; Waxman & Hall, 1993; Xu, Carey, & Welch, 1999).

If the children in the longer-term memory condition of Experiment 1 were drawing from a category representation of the mug, then it should be possible to arrange for the novel object to be treated in the same way as the mug. Specifically, the likelihood of depicting the novel object from an unseen viewpoint after restricted viewing should be increased by arranging for it to be named with a novel count noun prior to drawing from longer-term memory (cf. Walker, Blake, & Bremner, 2008, for supporting evidence from adults). No such effect would be expected when the novel object is drawn from short-term memory. Experiment 2 tests this hypothesis by asking young children to draw the novel object from short-term or longer-term memory, after restricted or unrestricted viewing, with the experimenter either naming the object with a novel count noun or not naming it.

Method

Participants

Two hundred and forty 5- to 7-year-olds participated (mean age = 6 years 5 months; age range = 5 years 0 months to 7 years 11 months).

Materials

The novel object used in Experiment 1 was the only object used in Experiment 2.

Design

An independent-groups design was created by crossing three factors, each with two levels. The factors were Object Naming (*object unnamed* versus *object named*), Viewing Condition (*restricted viewing* versus *unrestricted viewing*), and Memory Delay (*short-term remembering* versus *longer-term remembering*). An equal number of participants (n = 30)

were assigned randomly to each of the eight groups, with the constraint that the groups were matched for age and gender.

Procedure

Except for one change, the procedure was identical to that adopted in Experiment 1. The procedure was modified slightly for the *object named* condition. In this condition, as the object was being presented for inspection prior to being placed in position for drawing, the experimenter said "Look at this, this is a dax." When the object had been placed in position for drawing, with the cone hidden from view, the experimenter continued with "Look at this dax as it appears to you now, because tomorrow I want you to draw it as it appears to you now." Then, when the children returned the next day to draw the object, the experimenter continued with "Now, could you draw the dax you saw yesterday, just as you remember seeing it before I hid it under the box?"

Results

Figure 3 presents the number of drawings in each condition in which the object was depicted from a restricted viewpoint, as opposed to some other viewpoint.

Analysis of the likelihood of depicting the object from a restricted viewpoint confirmed the impact of viewing condition. Thus, aggregating across levels of object naming and memory delay, there were significantly more drawings in the *restricted viewing* condition, than in the *unrestricted viewing* condition, that depicted the object from a restricted viewpoint, *Fisher's Exact* $p < .001$.

In the *unrestricted viewing* condition, object naming had no effect on the likelihood of depicting the object from a restricted viewpoint, regardless of memory delay, $p = .76$ and 1.00, for short-term and long-term remembering, respectively. However, in the *restricted viewing* condition, object naming made it less likely that the object was depicted from a

restricted viewpoint, but only with long-term remembering, p = .001, and not with short-term remembering, p = 1.00.

Memory Delay had no effect on the likelihood of depicting the object from a restricted viewpoint in the *unrestricted viewing* condition, p = .18 and .47, for the *unnamed* and *named* conditions, respectively. However, it did have an effect in the *restricted viewing* condition, but only when the object was named. Specifically, whereas delaying the test of memory in the *restricted viewing* condition had no impact on whether the object was depicted from a restricted viewpoint when the object was not named, p = .42, it reduced the likelihood of this when the object was named, p = .032.

Finally, only five participants drew with their left hand. When handedness and gender were considered as factors, neither had a significant impact on the viewpoint from which the novel object was depicted in the children's drawings.

Discussion

Young children engaged in the object drawing task were induced to treat the novel object in the same way that children in Experiment 1 had treated the mug. Thus, when the object was named with a novel count noun as it was being inspected prior to drawing, their drawings from longer-term memory became independent of the viewpoints from which the object had been seen. Their drawings from short-term memory were not influenced by object naming.

Because naming a novel object with a novel count noun is known to induce children to establish a category representation for the object (cf. above), this new result helps to confirm that it was the availability of a visual category representation that allowed the children in Experiment 1 to draw the mug from longer-term memory in a way that was independent of the particular viewpoints from which it had been seen. This result also

confirms that visual category representations, in addition to providing the basis for generic depictions of sets of objects, can also contribute to the depiction of an individual object.

General Discussion

The results from the present experiments are consistent with the proposal that distinct types of visual object representation are differentially associated with short-term and longer-term remembering. Specifically, though viewpoint-dependent object representations and viewpoint-independent structural descriptions of object categories can both support short-term and longer-term remembering, the former representations tend to be most influential in short-term remembering, the latter in longer-term remembering. Given the relative insensitivity of GSD-like structural descriptions of object categories to orientation in depth, and their privileged links with object (category) names, it is understandable that both object familiarity and object naming induced children to depict objects in ways that were not constrained by the particular viewpoints from which the objects had been seen. The fact that this was observed only with longer-term remembering, and not with short-term remembering, confirms the three-way association between object categorisation, viewpoint-independence, and longer-term remembering.

Children in the restricted viewing condition were induced to depict the objects from a viewpoint from which the objects had not been seen, even though they had been requested to depict them from the final viewpoint from which they had been seen (i.e., with the handle/cone hidden from view). It could be argued, therefore, that object familiarity and object naming both impaired performance.

The potentially detrimental effects of object familiarity and object naming on visual remembering, and the restriction of these effects to longer-term remembering, have also been revealed in studies of visual image combination (cf. Brandimonte, Hitch, & Bishop, 1992;

Hitch, Brandimonte, & Walker, 1995; Walker et al., 1997). In these studies, participants were asked to combine a visual image of a recently presented line drawing with an image of a current line drawing. They were then to discover the identity of the object resulting from this combination. The nature of the to-be-combined drawings was such that identification of the emerging object required the superimposition of the two images in the mind's eye to be metrically accurate. In some situations, the recently presented visual stimulus was either still available in short-term memory (because no other item had been presented in the interim), or was available only in longer-term memory (because other task-relevant items had been presented in the interim). In addition, it was arranged that when the memory item depicted a familiar object, it was either named or unnamed at presentation. In agreement with the results of the present study, participants were *less* able to complete the image combination task if the object depicted in the first drawing was named at presentation. Moreover, this detrimental effect of naming was observed only with longer-term remembering, and not with short-term remembering. Walker et al. (1997) proposed that performance was impaired by object naming because this induced participants to increase their reliance on a visual representation of the category to which the object belonged, with the effect that the shape of the object became less accurately described (i.e., there was a shift towards shape being described categorically rather than with metric accuracy). Finally, additional support for the current proposal emerged with the observation that performance in the image combination task was insensitive to the colour congruity of the to-be-combined stimuli, but only when longer-term remembering was being assessed and the first of the two figures had been named (Hitch, Brandimonte, & Walker, 1995; Walker et al., 1997). With short-term remembering, image combination was impaired when the two figures to be combined appeared in different colours (e.g., black-on-grey and white-on-grey), rather than the same colour (e.g., both black-on-

grey), regardless of whether or not the first figure was named. In other words, whereas the visual representation supporting longer-term remembering resembled a GSD-like representation insofar as it did not preserve object colour, the visual representation supporting short-term remembering resembled an image-like representation insofar as it preserved object colour independently of object naming.

Much of the evidence confirming the impact of distinct types of visual representation in longer-term remembering has involved the contrast between implicit and explicit tests of memory (see, for example, Cooper, 1994, and Srinivas, 1996). For example, though long-term priming in object naming and object decision tasks has been shown to involve visual representations that do not preserve information about viewpoint and object colour, explicit recognition memory for the same stimuli has been shown to involve visual representations preserving information about these two features (Biederman & Cooper, 1991, 1992; Cooper, 1994; Cooper & Schacter, 1992; Seamon & Delgado, 1999; Seamon, Ganor-Stern et al., 1997; Srinivas, 1996). Clearly, therefore, a full account of the representational basis of visual remembering will need to acknowledge the distinction between implicit and explicit tests of memory. Nevertheless, the results reported here confirm that an explicit test of memory (i.e., the present object drawing task) can reveal the varying contributions of different types of visual representation. Although the image combination task also is a test of explicit memory that can do this, the object drawing task has the advantage that there are no restrictions on the stimuli that can be utilised.

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Footnote

[1] The terms viewpoint-dependent and viewpoint-independent are intended to refer to the extent to which the representation of an object is restricted to the viewpoint(s) from which the object has been seen. It is not intended to refer to the extent to which an object might be represented from a specific viewpoint (e.g., a canonical view), which could or could not be a viewpoint from which the object has been seen.

[2] Use of the term 'memory delay' is not intended to imply that the critical factor distinguishing short-term and longer-term remembering is the passage of time. Likely to be important is the interposition of other visual events requiring cognitive resources (e.g., attention), whether these events are external in origin (e.g., the presentation of another visual object), or internal in origin (e.g., the generation of a visual image from long-term knowledge).

Figure Captions

Figure 1. The number of children in Experiment 1 who depicted the object from a restricted viewpoint, as opposed to some other viewpoint, as a function of viewing condition, object familiarity, and memory delay.

Figure 2. For those children in Experiment 1 who drew the object from both short-term and longer-term memory, is shown the number of drawings in which the object was depicted from a restricted viewpoint, as opposed to some other viewpoint, as a function of viewing condition, object familarity, and memory delay.

Figure 3. The number of children in Experiment 2 who drew the novel object from longer-term memory from a restricted viewpoint, or some other viewpoint, as a function of viewing condition, memory delay, and whether the object had been named with a count noun at encoding.

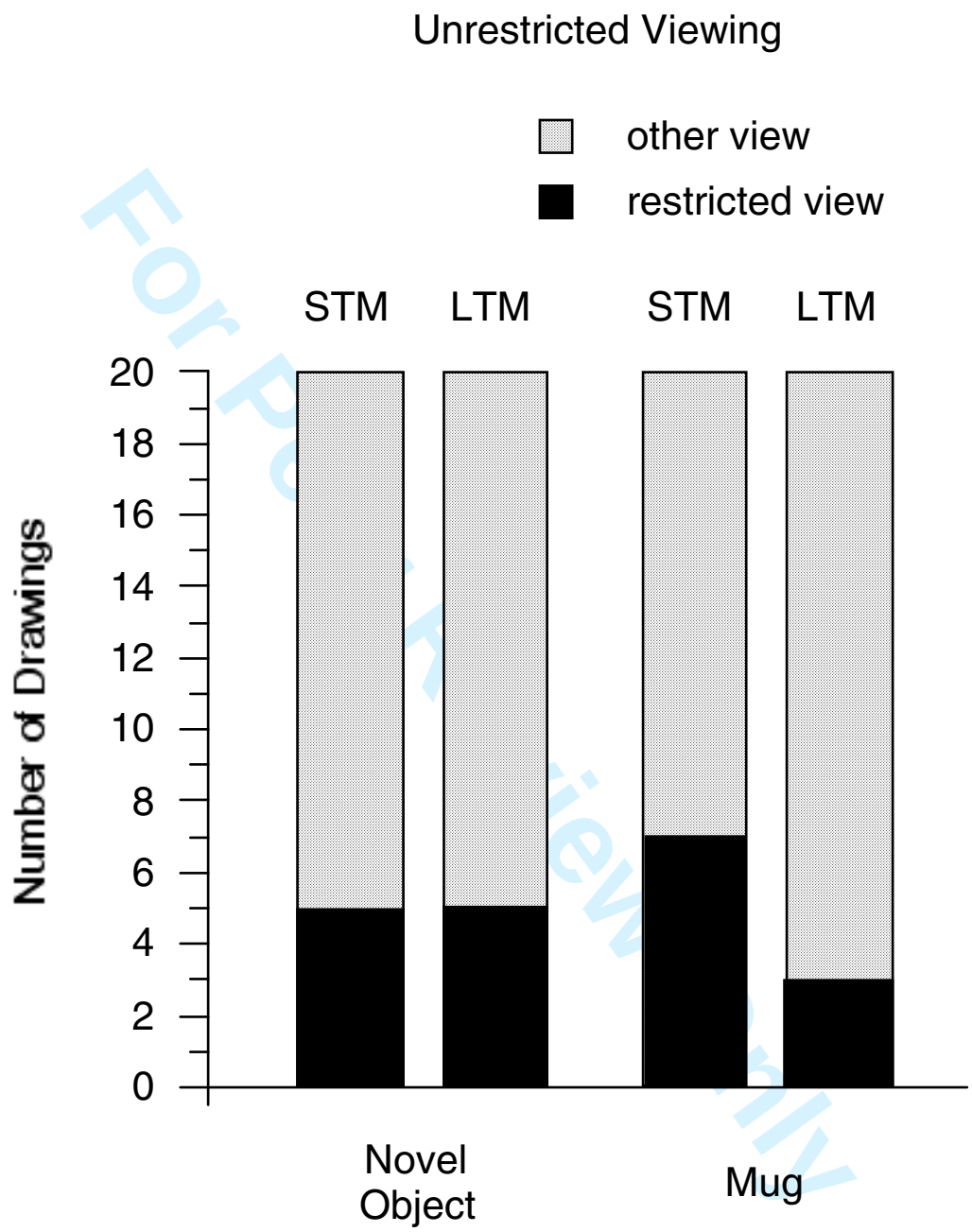
Unrestricted Viewing
other view
restricted view
STM
LTM
STM
LTM
Number of Drawings
20
18
16
14
12
10
8
6
4
2
0
Novel Object
Mug

Figure 1

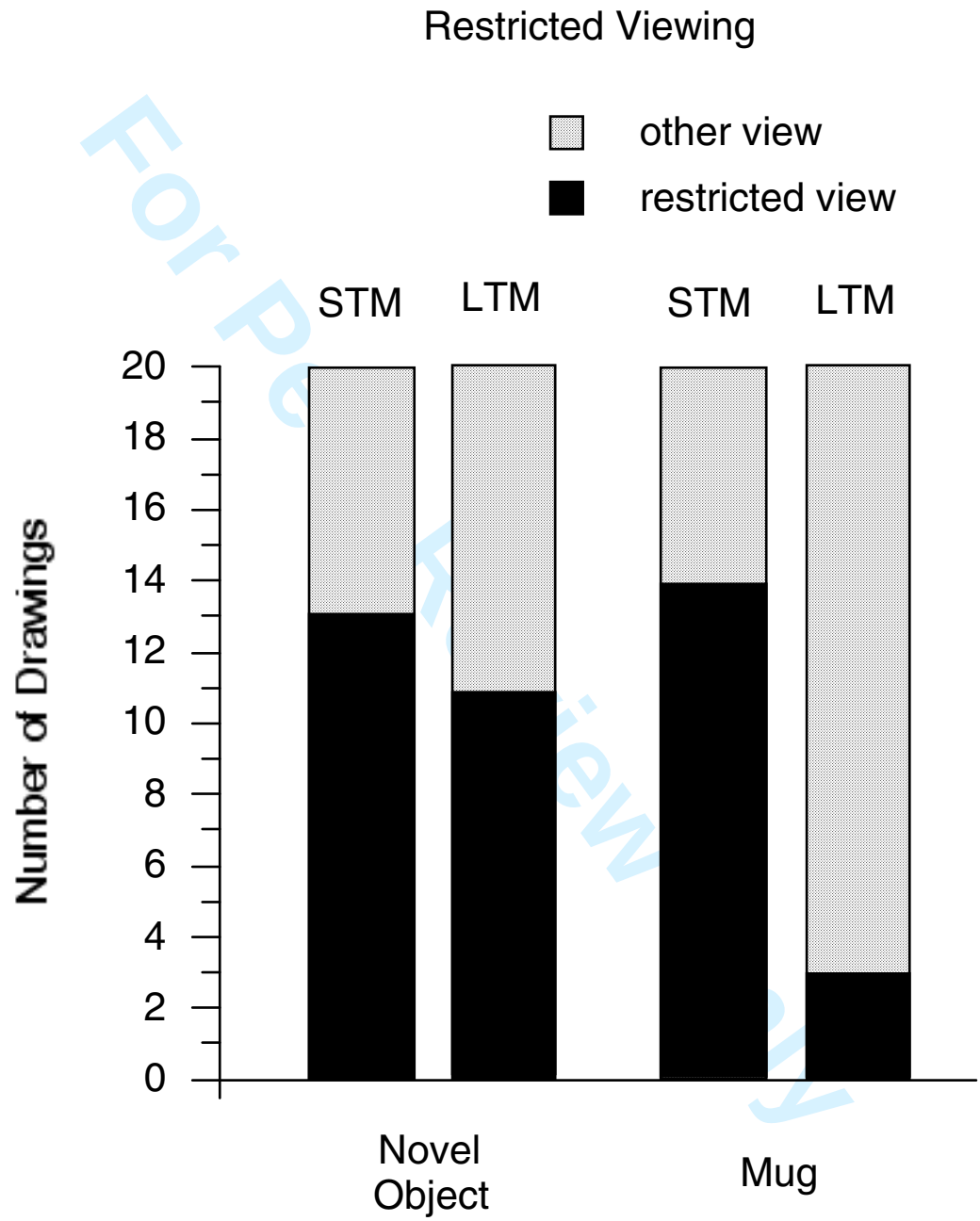

Figure 1 (cont'd)

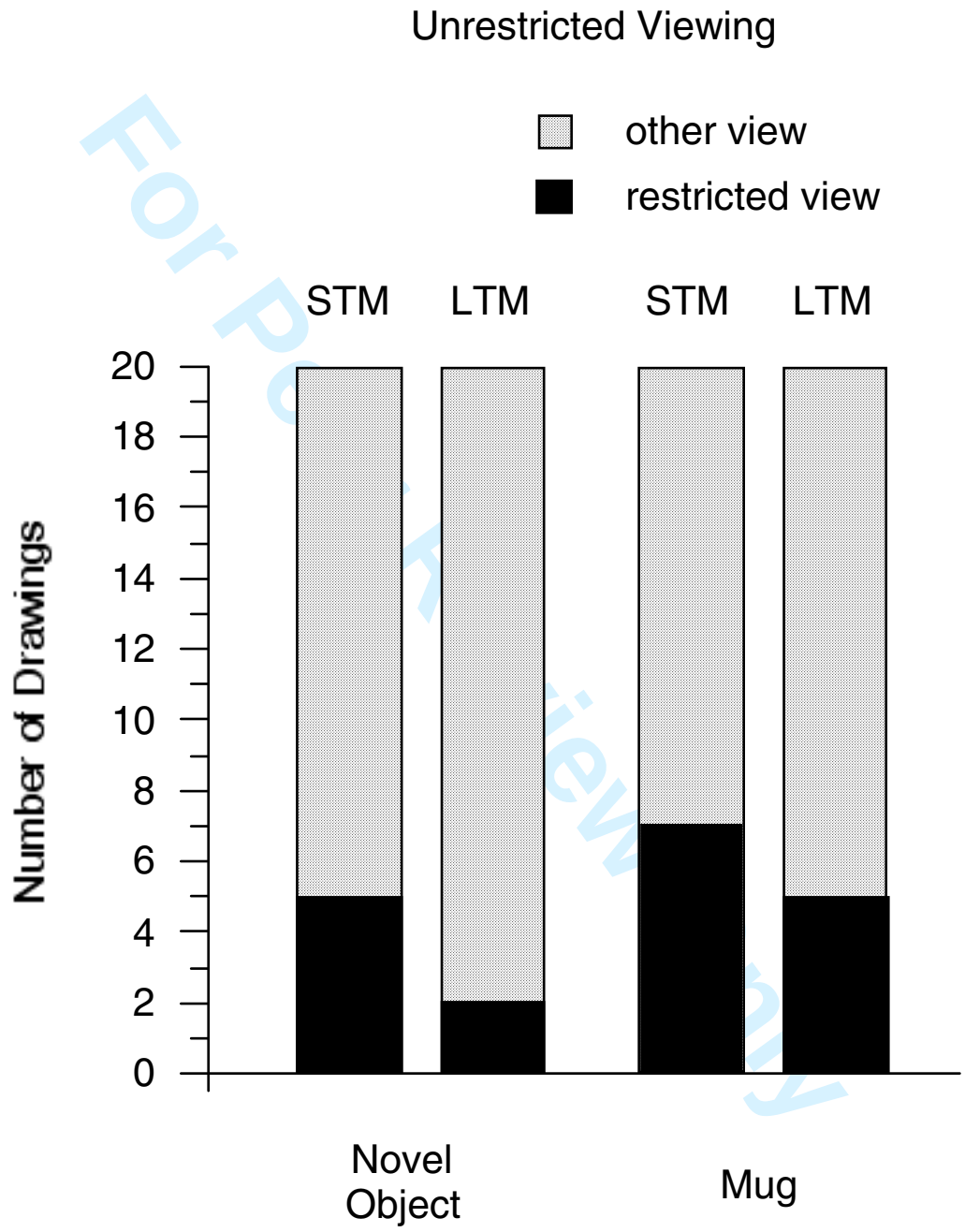

Figure 2

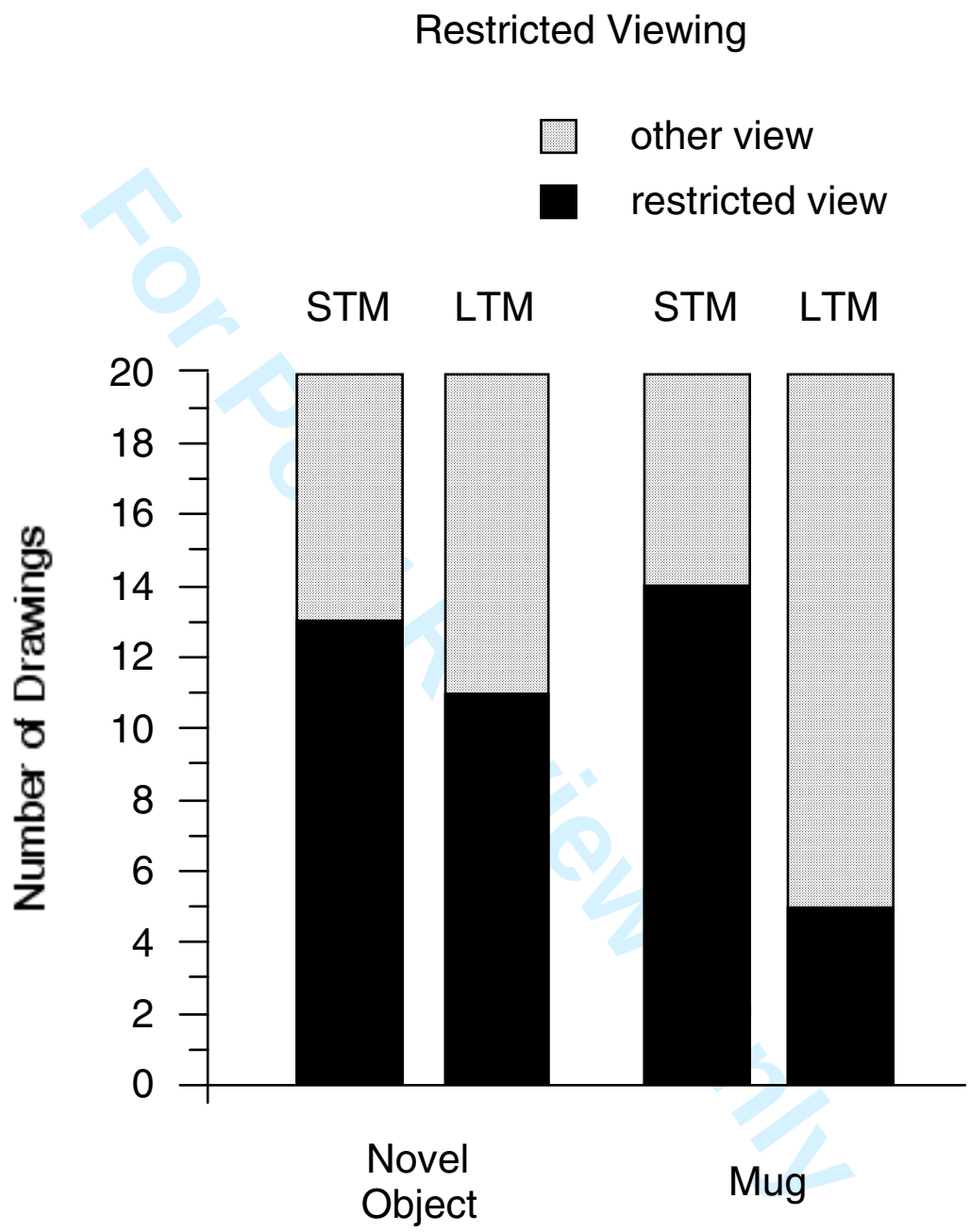

Figure 2 (cont'd)

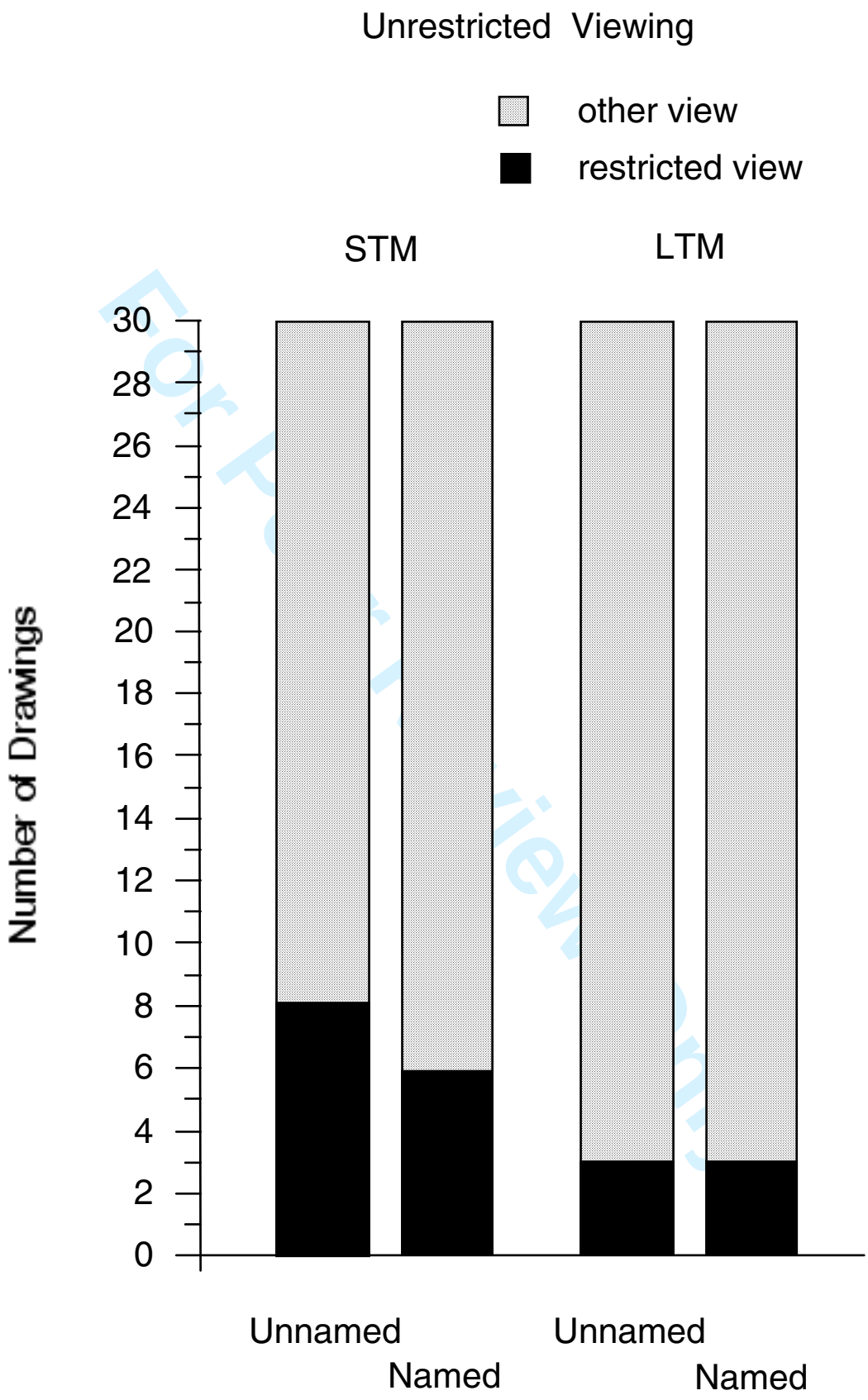
Unrestricted Viewing
other view
restricted view
STM
LTM
Number of Drawings
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Unnamed
Named
Unnamed
Named

Figure 3

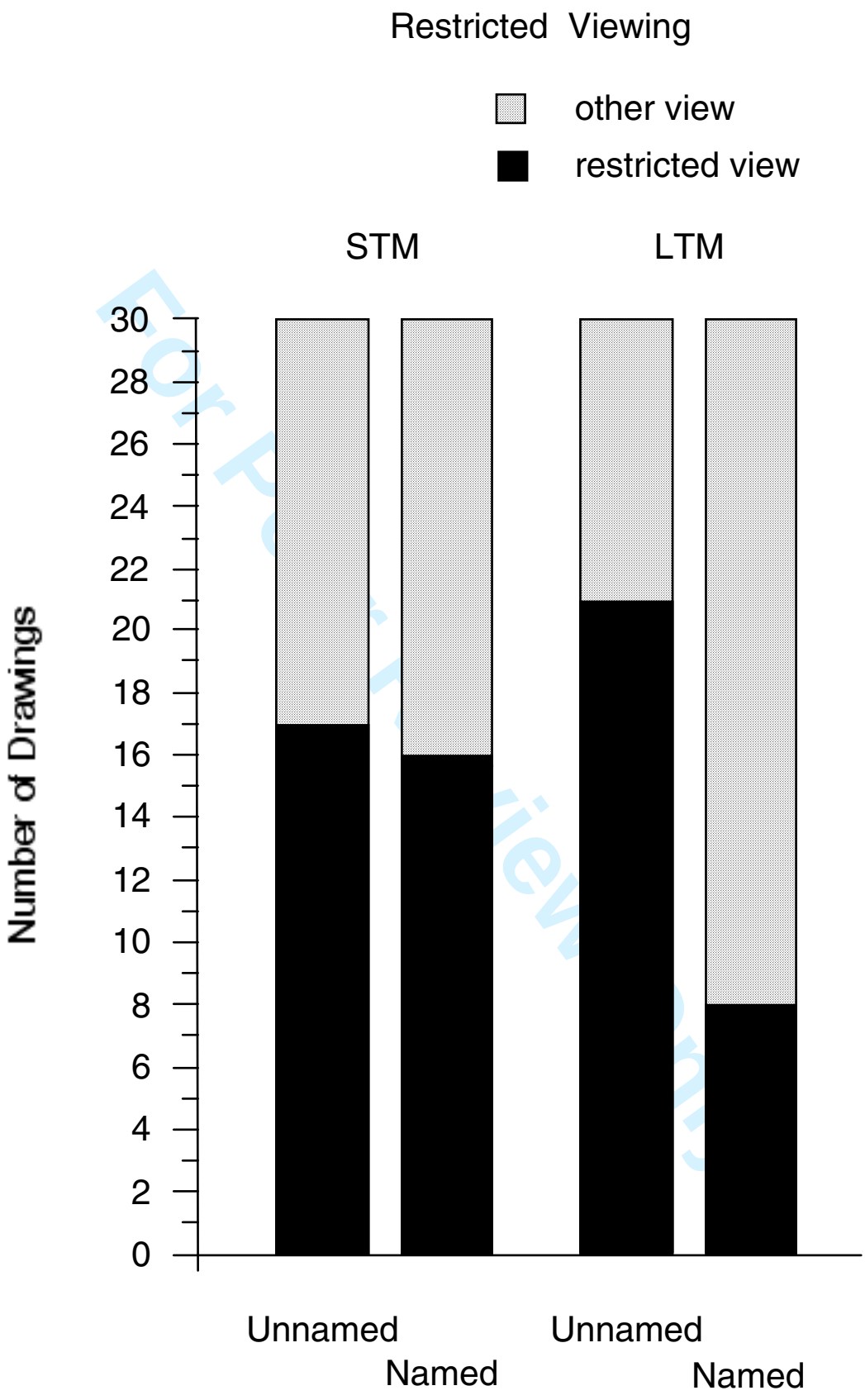

Figure 3 (cont'd)