Partition vs. compression: Memory domains and the processing of appositives

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Psycholinguists often assume a correspondence between (i) sentences or large prosodically/pragmatically marked sub-sentential linguistic units and (ii) **memory domains**, packages which influence storage and access [1-3]. Signatures of this packaging (**segmentation effects**) are expected in the processing of demarcated linguistic structures. This study seeks to reconcile existing claims about segmentation effects in memory for appositive relative clauses (ARCs) with other known effects of structure in memory.

A growing body of work has shown that ARCs (1a) are less impactful on subsequent processing than restrictive relative clauses (RRCs) (1b) [4-7]; e.g., ARCs produce less interference for filler-gap dependency resolution [5], and are less likely sources for agreement attraction [6,7]. This may be because, as large prosodically/pragmatically distinct units, the content of ARCs is stored in a separate memory domain and later rendered unavailable [5], perhaps due to **compression** in memory. This resembles other purported (prosodic) segmentation effects that reduce accessibility within memory [2].

This proposal contrasts with other apparent segmentation effects. Domain-general studies have shown that more structure improves memory and reduces similarity-based interference [8,9]. Modern content-addressable models of memory for language [10] may use structural divisions as distinguishing cues that **partition** the search space for retrieval operations. In these models, memory domains support faster, easier access.

We call these the **Compression** and **Partition** hypotheses of segmentation effects. Partition may offer an alternative understanding of [4-7]: ARCs often seem less available, because they set up a segmented search space, and so are more easily bypassed in certain operations. But Compression and Partition make different predictions about the strength of the representation of ARCs in memory. **Compression** predicts that ARCs should always be less accessible than RRCs, because ARCs are packaged away into a compressed memory domain. On the other hand, **Partition** expects that the presence of an ARC in a sentence should make all content easier to access, even ARCs when targeted directly, because ARCs support useful compartmentalization of linguistic input. We test these predictions here, finding new evidence against Compression for ARCs, and suggestive of Partition.

In **Expt. 1** (*n* = 48), a **recognition memory** task, 48 items crossed RC type (RRC vs. ARC) (1) and were followed by a recognition probe (2) after a math distractor. In DIFFERENT conditions, critical items differed from targets only in the argument frame within the critical RC. We collected binary "Same"/"Different" responses followed by 3-point confidence ratings, subjected to signal detection theoretic analysis [11] using pROC [12,13]. **Results** are in Fig./Table 1. The critical comparison of ARCs and RRCs reveals a small increase in sensitivity for ARCs, although this falls below significance ($D_{boot} = 1.76$, $p = 0.08$). This is incompatible with Compression, which expects reduced sensitivity for ARCs. It is more compatible with Partition, though still not evidence of enhanced memory for ARCs.

In **Expt. 2** (*n* = 72), a **A-Maze** task [14,15], 36 items contained two RCs. The second RC featured a nominal ellipsis site, and the first RC contained the ellipsis antecedent (3). RC types comprised three conditions: only RRCs [CONTROL], an ARC for the first (antecedent) RC [ARC-1], or an ARC for the second (ellipsis site) RC [ARC-2]. We collected response times on the region directly following the ellipsis site, and two additional spillover regions (in bold). **Results** are in Fig./Table 2. ARC-1 is not credibly different from the control; ARC-2 shows a small speed-up versus other conditions, though this is only credibly non-zero in the spillover. Compression's predictions for a slowdown are not met. Instead we have suggestive evidence for Partition: ellipsis resolution is slightly faster in sentences with ARCs. But Partition would expect this in ARC-1 and ARC-2. The Partition benefit may be partially offset in ARC-1 by: (i) an additional Compression effect for ARC-internal content, or (ii) an ellipsis resolution process that disprefers ARC-internal antecedents for semantic or pragmatic reasons.

In sum, our results suggest that ARCs are not less accessible in memory. In fact, the evidence tentatively suggests that ARCs make content more accessible, via finer structuring in memory. Future research will aim to extend this result in eye-tracking and listening.

(1) The father { a. , who cooked the kids a meal after the orchestra performance, ***(ARC)***
b. that cooked the kids a meal after the orchestra performance ***(RRC)*** }

was grateful for instant noodles.

(2) **Was this the same sentence you saw?**

Same: …cooked the kids a meal…

Different: …cooked a meal for the kids…

(3) The struggling author that published two novels resented the successful hack that published forty ___ **over the past** three decades. ***(Control)***

… author, who published two novels, … hack that published forty ___ **over the past**… ***(ARC-1)***

… author that published two novels … hack, who published forty ___ **over the past**… ***(ARC-2)***

x-x-x accomplish thinks anti democracy yeah jumper abrasion door surrounded wore know emergency sucks ***hear jack wear*** *sorry trained.* ***(Foils)***

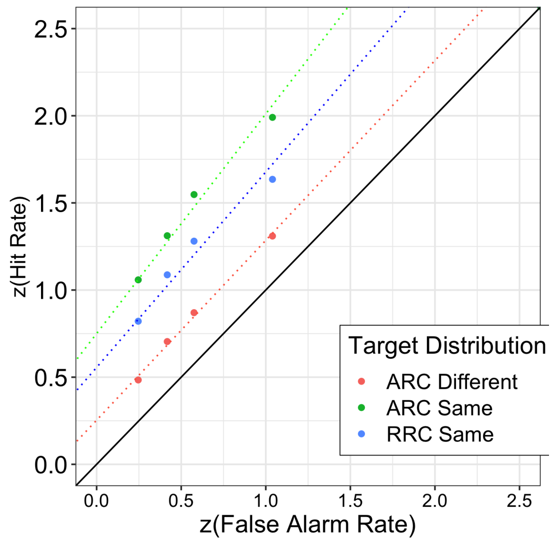

Fig. 1 zROC curve for E1, comparing each target distribution to the distribution of responses in RRC Different trials.

	d_a	AUC	2.5%	97.5%
ARC Same	0.84	0.67	0.64	0.70
RRC Same	0.64	0.63	0.60	0.66

Table 1 Critical signal detection measures for E1.

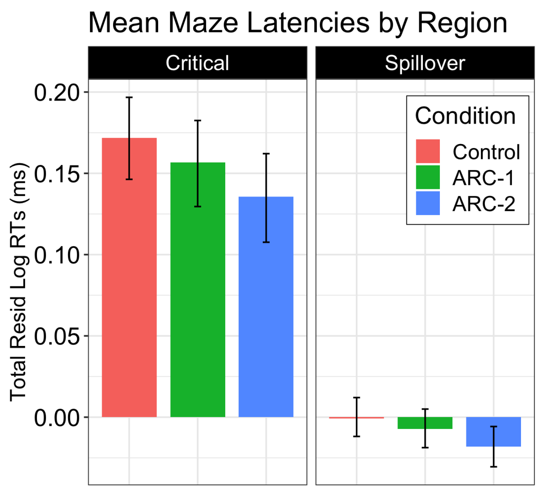

Fig. 2 Residualized log RTs at the critical and spillover positions in E2.

Effect	β	2.5%	97.5%	
C vs. ARC-1	-0.01	-0.05	0.02	CRIT
C, ARC-1 vs. ARC-2	-0.03	-0.08	0.02	
C vs. ARC-1	-0.01	-0.02	0.01	SPIL
C, ARC-1 vs. ARC-2	-0.02	-0.05	-0.0008	

Table 2 Weights from an lme model fit to residual log RTs in `brms` [16] for critical and spillover in E2.

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Preregistration: https://osf.io/u56np/?view_only=db2033be34a845fe9fbe414e3a2d569f
PCIbex [17] Demos for E1: https://farm.pcibex.net/r/YddJID/ **and E2:** https://farm.pcibex.net/r/gjbibw/