SUFFIX EFFECT

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1. Core Definition and Phenomenology

The **Suffix Effect** refers to the robust phenomenon observed in studies of immediate serial recall where the memory performance for the final item, or more commonly the penultimate item, of a presented list is significantly impaired when an irrelevant item--the "suffix"--is appended to the end of the sequence. This effect is a specialized form of acoustic interference, crucially impacting the highly advantageous recency effect normally associated with short-term memory retrieval. The **Suffix Effect** is not merely an indication of general distraction; rather, it represents a specific disruption of the mechanisms responsible for maintaining the last few items in the phonological store, particularly those items retrieved immediately before the interfering element.

Historically, research identified that when participants are asked to recall a list of items (such as digits or letters) in order, recall accuracy typically declines across the middle of the list but improves dramatically for the final one or two items--the characteristic recency effect. However, the introduction of an extra, non-to-be-recalled item at the end of the auditory sequence dilutes the distinctive memory trace of the true final list item, causing its recall probability to plummet. This dilution is often explained by the suffix merging acoustically or phonologically with the target list items, thereby compromising the temporal or ordinal coding of the series end.

The core demonstration of the phenomenon typically involves comparing two conditions: a control group that hears the list followed by silence (or a non-speech cue), and an experimental group that hears the same list followed by a spoken word or sound (the suffix). The dramatic reduction in accuracy for the last pre-suffix item in the experimental group provides conclusive evidence of the effect. This finding underscores the ephemeral and highly susceptible nature of acoustic information held in the immediate memory system, highlighting the specific vulnerability of the most recently acquired items to subsequent acoustic input.

2. Historical Context and Seminal Findings

The foundational establishment of the **Suffix Effect** is largely attributed to the pioneering work of Crowder and Morton in the late 1960s. Their research provided compelling empirical data supporting the necessity of an acoustic or speech-based input system for immediate memory storage, leading to the development of the Precategorical Acoustic Store (PAS) model. Crowder and Morton posited that auditory information is briefly held in this modality-specific store, and items retrieved from this store exhibit the robust recency effect.

A critical early discovery was the modality dependence of the effect. Crowder and Morton

demonstrated that the suffix must be presented acoustically (i.e., spoken aloud) to produce the maximal interference. When the list items were presented visually, adding an auditory suffix had a far smaller, or often negligible, impact on recall of the final item. Furthermore, if the list was auditory, but the suffix was a non-speech sound, such as a tone, the interference was significantly reduced compared to a spoken word. These findings solidified the view that the suffix interferes specifically with the processes governing the acoustic representation of the list items, rather than simply acting as a general cognitive load or masking agent.

Subsequent research refined these findings, emphasizing that the acoustic similarity between the suffix and the list items is a key determinant of the magnitude of the effect. If the suffix shares phonological features with the list (e.g., a list of letters followed by the word "go"), the effect is strong. If the suffix is acoustically distinct (e.g., a human voice list followed by a machine beep), the effect diminishes. These historical insights were instrumental in shaping major theoretical models of short-term memory, particularly those proposed by Baddeley and Hitch, which incorporated a specialized component for temporary acoustic storage, the phonological loop.

3. Necessary Conditions for Elicitation

The **Suffix Effect** is not a universally present phenomenon in all memory tasks; its reliable elicitation requires a precise set of experimental conditions, primarily centering on the modality and nature of the stimulus presentation. The most crucial condition is the requirement for the suffix to be interpreted as a speech sound, suggesting an obligatory, automatic entry into the phonological processing stream. Even if the suffix is identical to a list item (e.g., the final item is "B" and the suffix is "B"), its role as a non-target item is sufficient to cause interference, provided it is heard.

Furthermore, the acoustic characteristics of the suffix must be closely related to those of the target items. Experiments exploring the "who said what" factor demonstrated that if the list is spoken by one voice, and the suffix is spoken by a physically distinct voice (e.g., a different gender or pitch), the suffix effect is attenuated. This implies that the memory system can partially segregate input based on acoustic features, preventing the suffix from fully merging with the target items if the source characteristics are sufficiently distinct. This finding supports theories emphasizing the importance of source identification and auditory object formation in recall processes.

A final necessary condition relates to the type of recall task itself: the effect is strongest and most reliably observed in tasks requiring strict serial order recall. When participants are asked merely to recall the items in any order (free recall), the recency effect remains robust, and the suffix effect is significantly reduced or absent. This critical distinction suggests that the suffix primarily impairs the mechanism responsible for maintaining the *temporal distinctiveness* or *ordinal position* of the final item, rather than destroying the item's representation entirely.

4. Mechanisms of Interference

Two main classes of theoretical explanations attempt to account for the specific disruptive action of the suffix: the Feature Model and the Auditory Object/Obligatory Streaming Hypothesis. The mechanisms proposed vary in whether they focus on the degradation of memory features or the miscategorization of the input source.

Under the Distinctive Feature Hypothesis, the suffix interferes by reducing the temporal distinctiveness of the final list item. When a list is presented, the brain encodes not only the identity of the items but also their temporal context--the time marker associated with their input. The suffix, being the last input, shares temporal features with the target final item. Its presence essentially 'pushes back' the final item in the perceived temporal sequence, blurring the separation between the last target item and the retrieval cue (the moment recall is initiated). This temporal smearing makes the final item less unique or 'distinctive' in the memory array, leading to errors of retrieval, where the wrong temporal marker is accessed.

The second major explanatory framework, often rooted in Auditory Object processing, argues that the **Suffix Effect** occurs because the memory system obligatorily groups the suffix with the target list items. The non-target suffix is processed as part of the relevant auditory stream, thereby competing with the final target item for the privileged "final position" in the short-term store. This obligatory acoustic grouping is automatic and difficult to suppress, especially if the acoustic properties (like voice, intensity, and location) of the suffix match those of the list items. The presence of the suffix effectively captures the final, most advantageous slot in the memory buffer, displacing the intended final item and weakening its access probability.

5. Relationship to Models of Short-Term Memory

The **Suffix Effect** has served as a critical benchmark for validating and differentiating models of working and short-term memory, particularly those emphasizing modality-specific storage components. The existence of a robust, acoustically-driven interference mechanism strongly supported the initial conception of the phonological loop within Baddeley and Hitch's Working Memory Model.

In the context of the phonological loop, the Suffix Effect demonstrates the rapid decay and susceptibility to interference inherent in the temporary acoustic store. The list items are assumed to be maintained through subvocal rehearsal. When the suffix enters the system, it rapidly contaminates the short-term acoustic trace of the final item before rehearsal can fully consolidate it or before the retrieval process begins. Since the phonological loop is specifically dedicated to speech-based information, the strong modulation of the effect by acoustic properties (like voice quality) reinforces the modality-specific nature of this component.

Furthermore, the **Suffix Effect** plays a role in challenging models that rely purely on attentional mechanisms or generalized interference. If the effect were merely due to attention being drawn away, then any novel stimulus (visual, tactile, or non-speech auditory) should produce similar interference. The fact that the interference is maximal when the suffix is speech-like necessitates a model that includes specialized, precategorical auditory storage mechanisms that are sensitive to the input format and less dependent on conscious control or generalized executive attention processes.

6. Significance and Impact in Cognitive Research

The study of the **Suffix Effect** has been highly significant in cognitive research for several reasons, primarily due to its utility as an experimental tool to dissect the properties of short-term auditory memory. It provides a clean, controlled method for examining the temporal coding of information and the boundaries between acoustic perception and memory storage. Researchers can manipulate the acoustic characteristics of the suffix and precisely measure the resulting impairment to infer the underlying structure and limitations of the short-term memory buffer.

The consistent findings related to the Suffix Effect also offer crucial insights into language processing and auditory cognition. The mandatory nature of the grouping--where the auditory system processes speech as part of a sequence, even if explicitly instructed otherwise--suggests that the early stages of speech perception are highly automated and integral to short-term retention. This phenomenon helps distinguish between raw acoustic input and linguistically categorized phonemes, illuminating how the brain transitions from transient sensory perception to durable, ordered memory encoding.

Moreover, the systematic study of this effect has broader implications for understanding cognitive deficits. For instance, comparing the magnitude of the Suffix Effect in different populations (e.g., children, older adults, individuals with specific language impairments) can reveal developmental or clinical differences in the efficiency of the phonological loop and the robustness of temporal ordering mechanisms, thereby informing educational and clinical interventions aimed at improving verbal working memory capacity.

7. Debates and Criticisms

While the **Suffix Effect** is an undeniable empirical finding, its precise theoretical interpretation remains a subject of ongoing debate in cognitive psychology. One primary area of contention revolves around whether the impairment is due to a reduction in *item distinctiveness* (temporal coding failure) or *input categorization* (obligatory streaming).

Critics of the temporal distinctiveness approach often point out that while the effect is strongest for speech, it is not entirely absent for non-speech stimuli under certain conditions, suggesting that

while temporal coding is important, it may not fully capture the necessity of the speech modality. Conversely, those favoring the obligatory streaming hypothesis face challenges explaining why certain acoustic manipulations (like changing the voice of the suffix) can dramatically attenuate the effect, even though the suffix is still clearly speech. This suggests that the system is not entirely passive and can discriminate sources to some extent.

A further debate concerns the interaction between the Suffix Effect and proactive interference. Some models argue that the suffix acts less as a direct distractor and more as a cue that facilitates the immediate retrieval of items, potentially interfering with the established retrieval plan for the final list items. Disentangling the roles of acoustic feature masking, temporal disruption, and retrieval plan interference continues to drive experimental research into the precise cognitive architecture responsible for immediate serial recall.

Further Reading

Suffix effect - Wikipedia
Recency effect - Wikipedia
Phonological loop - Wikipedia
Psychology Dictionary Entry on Suffix Effect