

ERROR ANALYSIS

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ERROR ANALYSIS

Primary Disciplinary Field(s): Cognitive Psychology, Human Factors Engineering, Second Language Acquisition (SLA)

1. Core Definition

Error Analysis represents a systematic methodological framework employed across highly distinct disciplinary fields, primarily centered on the identification, classification, and ultimate explanation of deviations from a desired norm or outcome. This duality is critical: in **Human Factors Engineering** and organizational safety, error analysis investigates the causal links between equipment design, environmental conditions, and human behavior that lead to performance failure or accidents. The objective here is preventative, ensuring that the system or equipment design is studied rigorously **so as not to generate human error**.

Conversely, within the discipline of **Second Language Acquisition (SLA)**, error analysis is a systematic linguistic investigation. It involves analyzing a corpus of language produced by second language learners to precisely define how their linguistic forms deviate from the established norms of the target language. In this context, errors are not merely viewed as mistakes to be corrected, but rather as crucial, systematic evidence reflecting the internal structure and developmental stage of the learner's evolving language system, known as the interlanguage.

2. Historical Context and Dual Nature

The application of error analysis in engineering fields grew out of the need for improved safety and reliability following complex industrial and technological failures in the mid-20th century. Early approaches often focused solely on human negligence, but error analysis shifted the focus towards systemic deficiencies. This historical development formalized methodologies, moving from reactive investigation (post-accident) to proactive risk assessment, emphasizing that system design must inherently compensate for predictable human limitations, thus reducing the probability of catastrophic failure induced by operational oversight or poorly conceived interfaces.

The rise of error analysis in linguistics in the 1960s marked a significant theoretical pivot away from the dominant **Contrastive Analysis Hypothesis (CAH)**. CAH had emphasized that nearly all L2 errors could be predicted based on the structural differences between the learner's native language (L1) and the target language (L2). Pioneering linguists such as S.P. Corder demonstrated that many errors were not attributable to L1 interference, but were instead developmental, reflecting the learner actively forming and testing internal hypotheses about the L2 structure. This realization fundamentally repositioned the learner's errors as constructive evidence of learning, rather than destructive evidence of failure.

3. Error Analysis in Human Factors Engineering

In the realm of human factors, error analysis is integral to safety engineering, cognitive psychology, and ergonomic design. The goal is to maximize performance reliability and minimize risk in high-stakes environments, such as medical surgery, aviation, or power plant operation. Analysts meticulously categorize errors, distinguishing between slips (errors in execution), lapses (memory failures), and mistakes (errors in planning or judgment). This differentiation allows for highly specific interventions.

A typical human factors error analysis involves mapping the sequence of events leading to a failure, isolating the environmental or design triggers that predisposed the human operator to err. For instance, analyzing a control room error might reveal that poor grouping of instruments or ambiguous labeling led to a perceptual mistake. The resulting intervention is usually a physical redesign of the human-machine interface, ensuring controls are intuitive and feedback is unambiguous, thereby minimizing the cognitive load and reducing the incidence of error.

4. Error Analysis in Second Language Acquisition (SLA)

As a key research methodology in SLA, linguistic error analysis follows a rigorous, multi-step procedure. First, a representative corpus of learner language is collected, usually through written work, interviews, or oral tasks. Second, errors are systematically identified by comparing the learner's utterance against the corresponding well-formed target language form. Third, these errors are described and taxonomized, usually according to linguistic level (phonology, morphology, syntax, lexicon).

The final and most crucial step is the explanation of the error. Researchers attempt to determine the source of the deviation, often attributing it to internal factors such as overgeneralization of a newly learned rule (e.g., using "eated" instead of "ate") or external factors like instructional inadequacy. By viewing errors as systematic manifestations of the learner's **interlanguage**, researchers gain critical insights into the universal and specific psychological processes governing language acquisition.

5. Key Concepts and Related Methodologies (Human Factors)

Accident Analysis: This is a retrospective application of error analysis, involving detailed forensic investigation following an adverse event to uncover the sequence of technical, organizational, and human factors that contributed to the failure.

Failure Modes and Effects Analysis (FMEA): A proactive reliability engineering technique that systematically identifies potential failure modes within a system—including procedural and human failures--and assesses the severity and likelihood of their effects before they occur.

Fault Tree Analysis (FTA): A top-down, deductive graphical technique used to map the logical sequence of component failures, human errors, and environmental events that must occur for a specified critical system failure (the "top event") to take place.

6. Key Concepts and Related Phenomena (SLA)

Interlanguage: The unique and evolving linguistic system constructed by a second language learner. Error analysis provides the primary empirical data used to describe and model the structure and rules of this temporary system.

Language Transfer: The influence that the learner's native language exerts on the acquisition and production of the second language. Error analysis helps differentiate negative transfer errors, where L1 habits interfere, from developmental errors, which arise from L2 learning processes.

Fossilisation: The stabilization of certain non-target linguistic forms in the interlanguage, often resulting in permanent errors that resist correction, regardless of input or instruction. Error analysis is essential for identifying the specific linguistic features that have fossilized in a learner's speech.

7. Significance and Applications

The continued significance of error analysis lies in its profound methodological contribution to both safety and pedagogy. In safety-critical sectors, it drives a culture of systemic improvement, moving blame away from the individual and toward the structural environment. By providing empirical data on where and why systems are susceptible to failure, error analysis ensures compliance with regulatory standards and facilitates the deployment of inherently safer technologies and procedures. This analytical approach underpins modern principles of ergonomics and robust organizational design.

In educational contexts, error analysis remains the cornerstone for understanding the cognitive process of language learning. It provides language teachers with a sophisticated diagnostic tool, enabling them to construct targeted curricula and adjust teaching methodologies based on the learner's actual developmental needs, rather than relying on abstract grammatical schedules. By defining errors as systematic and necessary steps toward fluency, error analysis validates the learner's efforts and provides a positive framework for instructional intervention.

8. Further Reading

Error analysis (linguistics)

Human Factors and Ergonomics

Failure Modes and Effects Analysis (FMEA)

Interlanguage