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## Promoting Science in Specific Learning Disabilities: Three Kinds of Challenges

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### Abstract

The field of specific learning disabilities (SLDs) has faced three kinds of challenges. *Constitutional challenges* arise from classification and definitional complexities, identification issues, comorbidity, and ontological debates. *Internal challenges* include the inherent difficulties of scientific thinking that compete with intuitionism and confirmation bias, the lack of randomized controlled trials to evaluate interventions, the low rate of replication studies, publication bias, and the gap between research on evidence-based practices and implementation. External challenges include philosophical movements in academia, primarily social constructionism and cognitive relativism. They also encompass broader social trends such as neurological reductionism, educational fads, and political conformism. This article specifically focuses on the influence of cognitive relativism in the field of SLDs. Despite these challenges, the field has made incremental progress by committing itself to scientific inquiry. The fundamental purpose of research is truth-seeking, aiming to expand the knowledge base on how best to support students with SLDs. The development of cognitive theories of dyslexia illustrates the refining nature of scientific inquiry as it moves closer to the truth. Upholding rigorous scientific standards is crucial for the future development of the field, providing effective support and consistently enhancing educational outcomes for students with SLDs..

*Keywords:* Specific learning disabilities, constitutional challenges, internal challenges, external challenges, research, truth-seeking, progress

Specific learning disabilities (SLDs) gained official recognition as a disability category in the United States about 50 years ago (Martin, 2013). This recognition came about through the recommendations put forth by an advisory committee (U.S. Office of Education, 1968). The acknowledgment of

SLDs as a distinct disability category represented a significant turning point for special education and the understanding of SLDs. It also led to the integration of specific learning disability into the 1975 federal special education legislation now known as the Individuals with Disabilities Education Act (IDEA

2004), which ensures free and appropriate public education for all children with disabilities (Martin, 2013). Since the United States recognized SLDs as a disability category, many countries worldwide have also acknowledged SLDs and taken steps to provide educational support and accommodations for affected students.

SLDs is a multifaceted concept encompassing various intrinsic learning problems. SLDs are globally recognized as a heterogeneous group of disorders affecting specific academic skills, such as reading, writing, and mathematics, and are included in every major diagnostic classification system, such as the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013) and the International Statistical Classification of Diseases and Related Health Problems (ICD-11; World Health Organization, 2018). There is consensus that SLDs are not the same as reading disability despite reading disability having a high prevalence among types of SLDs (Anastasiou, 2018). In the United States, the term “specific learning disability” (referred to in the singular form according to legislation) represents the largest category of individuals with disabilities receiving federally mandated support through special education.

Since the federal recognition of SLDs, research has significantly improved our understanding of the cognitive, neurobiological, and environmental factors contributing to SLDs (Grigorenko et al., 2020). Two distinct types of SLDs, dyslexia and dyscalculia, have been extensively researched. Developmental dyslexia is characterized by a specific deficit in accurately and fluently reading individual written words and poor spelling abilities for single words. Core learning problems in reading and writing arise from an underlying deficit in the phonological component of language (Peterson & Pennington, 2015; Snowling, 2019; Snowling et al., 2020; Spanoudis et al., 2019).

Dyscalculia involves a core deficit in understanding and rapidly and precisely processing numerosities. Individuals with dyscalculia struggle to inherently map numerical symbols like “one” or “two” onto their corresponding numerosities; that is, mental representations of those quantities (Butterworth et al., 2011, 2018). Number sense and basic arithmetic abilities have been found across a wide range of species, indicating these numerical abilities are phylogenetically widespread and emerge.

Whereas dyslexia impacts word-level reading and spelling, dyscalculia reflects impairment in the basic ability to mentally represent and manipulate numerical sets. These two types of SLDs appear to be separate and distinct. Dyslexia and dyscalculia are characterized by specific cognitive deficits in language-related and numerical-quantities-related processing networks (Demetriou et al., 2024; Peterson et al., 2021). These weaknesses do not appear to involve central cognitive processes, which integrate information across cognitive domains (Demetriou et al., 2024).

### Challenges to SLDs Research

Research in the field of SLDs has faced significant challenges, which can be categorized as *constitutional*, *internal*, and *external*. These distinctions provide a conceptual framework for understanding the field’s complex history and trajectory. Table 1 highlights the primary challenges in the scientific inquiry of SLDs. This article will focus mainly on the external challenges that SLD research faces.

*Constitutional challenges* describe challenges intrinsic to SLDs. These challenges arise from how SLDs are historically conceptualized, defined, and understood as a theoretical construct. They represent a specific type of internal challenge rooted in the core nature of SLDs as a distinct domain of scientific study.

**Table 1**  
*Main Challenges in Scientific Inquiry of SLDs*

Constitutional Challenges	Internal Challenges	External Challenges
Classification and definitional issues	Intuitionism	Social constructionism
Identification issues	Confirmation bias	Cognitive relativism and the Rortyan influence
Comorbidity	Lack of randomized controlled trials	Neurological reductionism
Ontological debates	Low rate of replication studies	Political conformism
	Publication bias	Educational fads and non-scientific interventions
	Translating research into practice	

*Internal challenges* are common in scientific fields, particularly in applied sciences, that aim to solve real-world problems and develop practical solutions. These challenges arise from the inherent difficulties in conducting scientific research and implementing effective intervention strategies.

*External challenges* originate outside the field's inherent or internal complexities and instead pertain to philosophical and ideological movements in academia (e.g., social constructionism, cognitive relativism, postmodernism). They also include broader social trends (e.g., neurodiversity) and educational trends and fads (e.g., differentiated instruction based on learning styles, whole-language reading instruction, auditory integration therapy, and universal design for learning) that influence the direction of the field. These external forces can significantly shape academic perspectives and practices related to SLDs.

## Constitutional Challenges

The trajectory of scientific progress in SLDs is fraught with constitutional challenges that seem to perpetually be embroiled in conflicts related to issues of (a) classification and definitional, (b) identification, (c) comorbidity, and (d) ontological debates, balancing precariously and never truly achieving stability (Hallahan et al., 2005; Stanovich, 1989).

## Classification and Definitional Issues

Classification issues in SLDs refer to the challenges surrounding how SLDs are categorized and defined (Anastasiou, 2018). These issues mainly arise from the heterogeneous nature of SLDs, which can manifest in various areas such as reading, spelling, writing, math computation, and math reasoning. SLDs often co-occur with other neurodevelopmental disorders, adding to the complexity of their classification.

There is an ongoing debate about the definition of SLDs, particularly concerning the achievement-IQ discrepancy definition, the response to intervention (RTI) method of identification, and the role of cognitive processing abilities (Anastasiou, 2018; Fletcher et al., 2019; Fuchs et al., 2011; Snowling, 2019). The Individuals with Disabilities Education Act (IDEA) broadly defines SLDs, encompassing disorders in one or more basic psychological processes involved in difficulties with listening, thinking, speaking, reading, writing, spelling, or mathematical calculations. However, debates continue regarding the specific criteria for diagnosing SLDs and the extent to which different subtypes should be recognized as

distinct disorders (Anastasiou, 2018; Fletcher et al., 2019; Snowling, 2019).

One core issue is that unlike physical conditions such as measles or chickenpox, SLDs such as dyslexia do not present with a clear and consistent diagnostic profile (Snowling, 2019). Reading ability exists on a continuum in the population, with no clear boundary between “dyslexic” and “typical” reading skills (Snowling, 2019; Snowling et al., 2020). Given the dimensional nature of the reading ability, there are no clear-cut criteria. However, there is agreement on the core risk factors for reading disabilities, even if categorical definitions are debated. A concept and diagnostic label like “dyslexia” captures this scientific consensus (Anastasiou, 2018; Snowling, 2019). Although universally accepted diagnostic criteria for dyslexia are lacking, evidence-based interventions can significantly reduce its impact when properly identified and targeted (Anastasiou, 2018; Snowling, 2019; Snowling et al., 2020).

The search for a discrete reading disability category has not been successful, partly due to a narrow focus on bimodality and limited markers (Miles, 1993, 2006; Nicolson, 2016). Perhaps further taxometric studies could aim to identify distinct categories or taxa within a continuum of behavior. In physical medicine, conditions like hypertension and obesity are considered genuine health problems despite not being taxonic, but dimensional. Defining single-dimensional taxonic boundaries for SLDs requires specifying diagnostic thresholds, which remain somewhat arbitrary due to measurement errors (Fletcher et al., 2013; Miciak et al., 2016).

Taxometric studies have been employed to identify a taxon, which is a latent class or category (e.g., a disability category) that is distinct from typical behavioral functioning and other disabilities within a broader taxonomic system. Taxometrics encompasses a set of related empirical procedures designed to (a) differentiate classes/categories/types from continuous dimensions, (b) uncover the latent structure of psychological constructs, and (c) establish defining indicators of identified categories (Beauchaine, 2007; Meehl, 1995, 2004; Ruscio et al., 2011). However, there is no “gold standard” criterion for validating SLDs' symptoms as markers of a discrete latent trait, and SLDs phenotypes are inconsistently defined. A taxon would be indicated by abrupt changes in associations among behavioral indicators as symptom severity increases. For example, searching for a dyslexia taxon could include reading accuracy, fluency, and spelling of single words as a phenotypic set of variables. To date, taxometric studies have not been

widely and properly applied to SLDs subtypes (Anastasiou, 2018).

## Identification Issues

The process of identifying students with SLDs has been contentious over the years, with disputes over the use of IQ-achievement discrepancy models, RTI approaches, and the role of cognitive assessments (Anastasiou, 2018; Fuchs et al., 2011; Hale et al., 2010; Snowling et al., 2020). Debates surrounding the identification of SLDs have resulted in inconsistent practices among states and school districts throughout the United States. These inconsistencies have raised concerns regarding the accuracy, variability, and equity of the processes used to identify students with specific learning disabilities (Maki et al., 2015).

## Comorbidity

“Comorbidity” refers to the co-occurrence of neurodevelopmental disorders. SLDs often co-occur with other developmental disorders, such as attention-deficit/hyperactivity disorder (ADHD) and anxiety disorders. Rates of comorbidity between reading disorder and math disorder range between 11–70%, reflecting a high degree of overlap between these two specific learning disorders. Rates of comorbidity between reading disorder and behavioral disorders (such as conduct disorder) and between reading disorder and ADHD range between 20–50%, indicating that attentional and behavioral issues frequently co-occur with reading disabilities (Moll et al., 2020).

There are two forms of comorbidity: (a) One disorder preceding and potentially causing another (e.g., developmental language disorder leading to dyslexia), and (b) two distinct disorders co-existing (e.g., dyslexia and developmental coordination disorder) (Snowling, 2019). Comorbidity adds another layer of complexity to the definition and identification of SLDs, making it difficult to isolate SLDs from overlapping conditions. Comorbidities also complicate interventions, but there is ongoing research into how to best address comorbidity issues for students with dyslexia, although there are no clear solutions yet (Snowling, 2019).

## Ontological Debates

Although further investigation into potential subtypes, underlying causes, and tailored interventions is warranted, the ongoing debate questioning whether dyslexia should be regarded as a distinct

disorder separate from general reading disabilities could hinder scientific advancement (Ramus, 2014; Snowling, 2019; Snowling et al., 2020; cf. Elliott & Grigorenko, 2014). Overall, there is strong scientific validation for the existence of dyslexia as a specific learning disorder (Snowling, 2019). Although researchers may justifiably lack full consensus on the precise phenotypic manifestations, this lack of agreement has implications for accurately conceptualizing SLDs and impedes research progress. Nonetheless, formally recognizing and labeling conditions like dyslexia and other SLDs remains critically important for ensuring students receive the necessary educational support and accommodations they require. Despite debates around their definitions, this underscores a compelling rationale for retaining such diagnostic labels (Ramus, 2014; Snowling, 2019; Snowling et al., 2020).

Partly due to these constitutional challenges, the field of SLDs is perpetually embroiled in conflicts and lacks stability. This instability can hinder the accumulation of knowledge, as researchers may struggle to build upon previous work, creating an obstacle to conducting rigorous and replicable research on SLDs. They can also impede a comprehensive understanding of the underlying mechanisms and factors contributing to these disorders. Overcoming these challenges through interdisciplinary approaches and a commitment to empirical evidence is crucial for advancing scientific knowledge and improving outcomes for individuals with SLDs.

## Internal Challenges

Internal challenges often arise within a field when conducting scientific research. Such challenges relate to (a) intuitionism vs. scientific thinking, (b) confirmation bias, (c) lack of randomized controlled trials, (d) low rate of replication studies, (e) publication bias, and (f) translating research into practice. Although these internal challenges are common issues across applied fields in social sciences, we here focus specifically on SLDs. Internal challenges within the field of SLDs can impede scientific progress in two primary ways: (a) they create barriers to conducting rigorous and replicable research studies, and (b) they lead to difficulties in effectively translating and implementing research findings into practical educational settings.

## Intuitionism vs. Scientific Thinking

Scientific thinking does not come naturally to humans (Cromer, 1993; Lilienfeld, 2010). Our minds

typically recognize patterns and jump to intuitive causal explanations based on unsystematic observations and personal experiences. Scientific thinking requires us to override our quick and intuitive hunches (intuitionism) in favor of experimentation, convincing empirical data, and rational thinking (Bunge, 1962, 1996, 2017). Bunge (1962) defined intuitionism as the tendency to derive propositions through instant, total, unquestionable, and infallible insight. Intuitionism is similar to what Daniel Kahneman (2003, 2011) describes as *system 1 thinking*, which operates automatically and quickly with little or no effort and is fast, intuitional, subconscious, and emotional. Intuitionism bypasses the need for empirical evidence and careful reasoning. Although various intuitions are useful to science, intuitionism is an obstacle to pursuing truth and advancing knowledge (Bunge, 1962, 1996).

Science requires withholding judgment until hypotheses can be systematically tested through carefully controlled experiments that rule out alternative explanations. *Scientific thinking* is an effortful, controlled, analytical, resource-intensive, and slow mode of thinking based on experimentation and empirical evidence (Bunge, 1962; Cromer, 1993; Lilienfeld, 2010). It may arise from what Kahneman (2003, 2011) has called *system 2 thinking* or *slow thinking*. Scientific thinking sometimes appears heretical and at odds with how we typically make sense of the world (Bunge, 1962; Cromer, 1993; Lilienfeld, 2010).

For a considerable period, the prevailing intuitional view regarded dyslexia as a visual perception deficit, suggesting that individuals with dyslexia struggled to read due to perceiving letters and words in reverse order or experiencing other visual distortions (Vellutino, 1979). This notion gained traction from Orton's (1925, 1937) brain lateralization hypothesis, which emphasized problems with orientation and sequencing in letter and word identification, such as confusing "b" with "d" or "was" with "saw." However, empirical evidence has shown that the core root of dyslexic difficulties is a phonological processing deficit—difficulty mapping letters to their corresponding speech sounds (Snowling, 2019; Snowling et al., 2020). This counter-intuitive finding challenged the long-held intuitional view that dyslexia is primarily a visual perception deficit.

### Confirmation Bias

Confirmation bias is the most virulent example of the destructive power of cognitive bias (McIntyre, 2020). It can lead researchers to inadvertently seek

out, interpret, and prioritize information confirming their preexisting beliefs or hypotheses while minimizing or dismissing evidence contradicting their beliefs. As such, it can compromise research findings' objectivity and validity (Cook, 2014; Lilienfeld, 2010; Nickerson, 1998). A valuable feature of authentic scientific inquiry is that it can prove us wrong (Lilienfeld, 2010).

Confirmation bias manifests in many contexts, including hypothesis testing, belief perseverance, and information search and interpretation (Nickerson, 1998). In the complex and theoretically diverse field of SLDs, confirmation bias can cause researchers to inadvertently skew their study design, data analysis, reporting of findings, and interpretation to support their preferred hypotheses or theoretical frameworks (Cook, 2014; Lilienfeld, 2010; Lilienfeld et al., 2012). Moreover, the emotional investment researchers may have in their theories or interventions can exacerbate confirmation bias, leading to the publication of biased findings that overstate the effectiveness of certain approaches (Coyne et al., 2016). Biased research can also lead to the adoption of ineffective or even harmful practices in the assessment and treatment of individuals with SLDs.

Despite individual scientists' efforts to avoid confirmation bias, it often only becomes apparent through peer review or post-publication scrutiny (McIntyre, 2020). However, peer review is an imperfect safeguard against bias (Cook, 2014). Strategies such as pre-registration, transparent reporting, and collaboration with researchers holding diverse scientific perspectives are recommended to mitigate confirmation and other forms of bias (Cook, 2014; Makel & Plucker, 2014).

While confirmation bias is not the only bias in conducting research (see Travers, 2017, for a series of cognitive biases), it is perhaps the most important cognitive obstacle because it can significantly influence the entire research process, from formulating hypotheses to interpreting results (Lilienfeld, 2010; Lilienfeld et al., 2012; Nickerson, 1998).

### Lack of Randomized Controlled Trials (RCTs)

RCTs are often considered the gold standard for assessing the effectiveness of interventions. In RCTs, participants are randomly assigned to either an intervention group or a control group that receives "business-as-usual" instruction. The outcomes of the intervention group are then compared to those of the control group. While RCTs are prevalent in medical re-

search, they are less common in educational research, including studies involving students with SLDs. Yet, they offer the most reliable method for determining whether an educational program is genuinely effective and can also identify the mechanisms that make a method effective (Bunge, 2013; Cook & Cook, 2013; Hulme & Melby-Lervåg, 2015; Snowling, 2019).

### Low Rate of Replication Studies

Replication is the process of reproducing research findings, which is essential for validating results and building scientific knowledge (Cook, 2014). That is, replication is vital for establishing the generalizability of results and identifying boundary conditions, allowing the field to refine its theories (Morrisson, 2022). As Ioannidis (2005) summarized,

[A] research finding is less likely to be true when the studies conducted in a field are smaller; when effect sizes are smaller; ... when there is greater flexibility in designs, definitions, outcomes, and analytical modes; when there is greater financial and other interest and prejudice; and when more teams are involved in a scientific field in chase of statistical significance. (p. 696)

Very few replication studies are conducted in social sciences, including special education. The alarmingly low rates of replication studies in education research, as documented by Perry et al. (2022), which approximate the findings of Makel and Plucker's (2014) study, pose a significant internal challenge to scientific credibility. With only around 0.20% or 1 in 500 education publications being replications, most findings are not rigorously verified (Perry et al., 2022). Makel et al. (2016) investigated the prevalence of replication studies in 36 special education journals, finding that only 0.5% of all articles (229 out of 45,490) were explicit replications. This replication rate was 3.75 times higher than that in general education research (0.13%), as reported by Makel and Plucker (2014), but less than half the rate found in psychology journals (1.07%).

The reproducibility rate was over 80%, meaning more than 80% of the replication studies successfully reproduced the results of the original studies. However, replications were significantly more likely to be successful when an author or co-author of the replication study was also an author or co-author of the original study (Makel et al., 2016).

The low rate of replication studies raises doubts about the extent to which special educational research is cumulative and self-correcting. In other words, the knowledge base of special education still

rests on a fragile foundation. Addressing the replication problem should be a top priority for strengthening special education as a scientific discipline (Cook, 2014; Makel et al., 2016).

### Publication Bias

Positive results are more likely to be published than negative or null results, leading to overestimating the effectiveness of interventions for students with SLDs (Cook & Therrien, 2017; Therrien & Cook, 2018). Negative or null findings can be critical to the scientific process, as they help identify ineffective practices, refine theories, spur new research, and increase efficiency (Therrien & Cook, 2018).

Negative or null findings substantiate the falsifiability function, which is critical to science, as is the confirmability function, the ability to confirm hypotheses (Bunge, 1996, 2017). Falsifiability ensures that scientific theories, including social hypotheses and theories, remain testable and subject to rejection based on empirical evidence (Bunge, 1996, 2017; Popper, 1935/1959/2002). It is a demarcation criterion for distinguishing science from pseudoscience through the systematic use of empirical evidence (Bunge, 1996, 2017; Popper, 1935/1959/2002). However, negative or null findings are relatively scarce in the published literature across many fields, including SLDs.

Publication bias refers to the tendency for journals to disproportionately publish studies with positive, significant findings over those with null results, leading to an incomplete and positively skewed research base. Potential reasons include researchers not submitting null studies and reviewers/editors rejecting them (Cook & Therrien, 2017; Therrien & Cook, 2018). Publication bias leads to positively skewed research bases that do not reflect the full range of findings. Thus, meta-analyses and systematic reviews that inform policy and practice in special education may be distorted by publication bias, leading to inaccurate conclusions about the effectiveness of interventions (Therrien & Cook, 2018). To examine the prevalence of null findings, Therrien and Cook (2018) analyzed studies published between 2012 and 2017 in three major learning disabilities journals. Only 0.8% of total articles and 4% of intervention studies reported all null results. However, 42% of intervention studies reported mixed findings, with some results being null and others positive (Therrien & Cook, 2018).

To address publication bias in SLDs research, it is essential to promote the publication of all well-conducted studies, regardless of their results. Research-

ers, journals, and funding agencies should prioritize transparency and disseminating both positive and negative findings. Additionally, pre-registration of studies and using study registries can help reduce the impact of publication bias (Cook & Therrien, 2017; Fleming & Cook, 2022; Therrien & Cook, 2018).

### Translating Research Into Practice

There is often a significant gap between research findings and their application in real-world settings (Cook & Odom, 2013; Fixsen et al., 2013). While research has identified evidence-based practices (EBPs) for addressing the needs of students with SLDs (e.g., explicit instruction, phonemic awareness instruction, phonics instruction, mnemonics), the adoption and implementation of these practices have been inconsistent (Fixsen et al., 2013).

Several factors contribute to the gap between research and practice in implementing EBPs for students with SLDs: (a) *Lack of training*: Teachers often do not receive adequate training on effective EBP implementation (Cook & Odom, 2013); (b) *Resource constraints*: Schools may lack essential resources such as time, materials, or support staff, leading to inconsistent implementation of EBPs (Cook & Odom, 2013); (c) *Resistance to change*: Some educators resist adopting new methods, especially if they believe their current practices are adequate or are skeptical about the effectiveness of EBPs (Cook & Odom, 2013; Fixsen et al., 2013); and (d) *Variability in student needs*: The diverse needs of students with SLDs make it challenging to apply a one-size-fits-all approach. Tailoring EBPs to individual students requires additional time and effort from teachers (Cook & Cook, 2013; Cook & Odom, 2013).

Successful implementation of EBPs requires both effective interventions and effective implementation methods. Fixsen et al. (2013) proposed a simple formula: Effective interventions  $\times$  effective implementation = improved outcomes. Setting up EBPs to achieve socially significant outcomes requires establishing implementation capacity, which involves developing state-level infrastructure for statewide implementation (Fixsen et al., 2013).

### External Challenges

External challenges facing the field of SLDs stem from broader sociocultural forces and academic, philosophical, and ideological movements. These external challenges include (a) social constructionism, (b) cognitive relativism and the Rortyan influence, (c) neurological reductionism, (d) political conform-

ism, and (d) educational fads and non-scientific interventions like differentiated instruction based on learning style preferences. Although these forces have originated outside the field's core, they have significantly influenced academic viewpoints and practices related to SLDs.

Some influential philosophers of the 20th century (e.g., Bruno Latour and Michel Foucault) embraced extreme cognitive relativism and advocated for a form of social constructionism that poses a significant challenge to the quest for truth in scientific exploration (Anastasiou, Burke, et al., 2024; Kauffman & Sasso, 2006a, b; Kauffman et al., 2017). Proponents of this viewpoint contend that in the discovery of facts, scientists are active creators of facts and reality. Conducting their ethnographic study entitled *Laboratory Life: The Construction of Scientific Facts*, Latour and Woolgar (1979/1986) spent two years observing and participating in the daily activities of a neuroendocrinology research laboratory at the Salk Institute in California. They concluded that scientific facts are not discovered but are the product of a social process involving negotiations, interpretations, and persuasion among scientists (Latour & Woolgar, 1979/1986). They also claimed that the thyrotropin-releasing hormone is a social construction. In their words: "But it would be incorrect to conclude that the TRF [Thyrotropin-releasing factor] story only exhibits the partial influence of sociological features. Instead, we claim that TRF is a thoroughly social construction" (Latour & Woolgar, 1979/1986, p. 152). This extreme social constructionist perspective implies that what we know as scientific facts is heavily influenced by the sociocultural context within which scientific inquiry occurs, challenging a mind-independent reality and/or the possibility of approaching truths.

Bunge (1999) criticized Latour and Woolgar's (1979/1986) study on the following grounds: (a) a biological laboratory cannot be treated as an ordinary social system, such as a tribe or a fishing village, due to the specialized and sophisticated processes involved in scientific research; (b) non-experts in biology visiting a laboratory are limited to observing superficial, behavioral aspects of the research process, as they lack the necessary background knowledge to comprehend the work being conducted by the biologists; and (c) a lack of understanding of the scientific process hinders the ability of outside observers to draw meaningful conclusions about the nature of scientific knowledge production (Bunge, 1999).

Moreover, Latour (1988) contended that science is a form of politics. In his own words: "Science is not

politics. It is politics by other means. But people object that ‘science does not reduce to power.’ Precisely. It does not reduce to power. It offers *other means*.” (Latour, 1988, p. 229; emphasis in the original).

### **Social Constructionism and SLDs**

Social constructionism is a philosophical approach that highlights the crucial role of society and culture in shaping our perceptions of reality. This movement encompasses a range of perspectives. In its mild and “folk sociology” form (so called since we all engage in sociological thinking to some extent), society and culture influence our perceptions of reality, including concepts like disability—a generally accepted notion that requires no further debate. However, this widely accepted yet unnuanced view can become a thinking trap, paving the way for more extreme forms of social constructionism to gain traction.

In its moderate form, social constructionism highlights how societal interactions and cultural contexts influence our understanding of the world. In its extreme form, it questions the existence of an objective reality that exists independently of human perceptions and beliefs, proposing that what we consider to be true or real is heavily mediated by human perspectives that reflect cultural norms and socio-political environment.

The original British social model of disability, as conceptualized by Mike Oliver (1990, 1996), applies a radical social constructionist approach to disability issues. The model distinguishes between impairment and disability on an ontological level. Impairment refers to the body’s physical limitations, whereas disability refers to societal disadvantage and is not seen to be related to the impairment. Thus, disability is seen as a distinct phenomenon from impairment, arising solely from societal barriers and attitudes that exclude and marginalize individuals with impairments (Anastasiou & Kauffman, 2011, 2012, 2013). Oliver (1990, 1996) went even further, asserting that disability is a form of social oppression (see Anastasiou & Kauffman, 2011, 2013, for an analysis).

#### **Moderate Social Constructionism and SLDs**

When social constructionist views are applied to SLDs, they provide a range of interpretations that vary in intensity. In a moderate application of social constructionism, the primary cause of SLDs is seen as social and cultural circumstances, encompassing the demands of the social environment, including schooling, family, teacher-student interactions, and cultural factors (Artiles et al., 2011; Coles, 1987; Tefera & Artiles, 2023).

Coles (1987) proposed a theory of interactivity for SLDs, referring to interactive processes between learners and their environments to explain the learning challenges children with SLDs encounter. He specifically described how these children often find themselves entangled in a complex network of unrealistic or erroneous expectations set by schools and those common among middle-class families. In Coles’s (1987) words,

Thus, the actual contradiction that can contribute to a learning and reading disability may be between the school’s erroneous expectations (and thus methods) and children’s acquisition of prerequisite abilities developed through interactions and experiences mediated primarily within the family. Because all parents are not able to help their children attain the prerequisite abilities the schools expect, and because the schools do not modify their expectations for each student, the children’s learning and reading are likely to suffer. And if children are judged to be lacking the “necessary” abilities, it is because schools have established a curriculum that begins at a level higher than it should. (p. 155)

It is important to revisit Coles (1987) when addressing the challenges posed by moderate social constructionism. Although Coles made valid points about understanding SLDs during his time and sought to offer an alternative perspective that avoided excessive social reductionism, he still emphasized the deterministic influence of social, family, and school conditions on SLDs in his interactivity theory.

Of course, the interplay between genetic and neurobiological factors and environmental and cultural influences is vital to our understanding of SLDs. For example, the orthographic characteristics unique to each language notably impact the expression and severity of challenges of children with dyslexia, including reading and spelling difficulties (Caravolas et al., 2013; Snowling, 2019).

To clarify, the interactionist approach is not a feature of moderate social constructionism. There are interactional approaches that draw on empirical research. For example, Frith (1997) offered an interactionist/emergentist framework that integrates four distinct levels of explanation: biological (including genetic and neurobiological factors), cognitive, behavioral, and environmental. She argued that a comprehensive understanding of dyslexia necessitates examining this condition from all four perspectives, highlighting the intricate and multifaceted nature of the disorder. Similarly, Morton (2004) provided a multidimensional framework to comprehend devel-



opmental disorders like dyslexia, highlighting the significance of biology, cognition, and behavior in understanding the underlying nature of these disorders.

Both Frith (1997) and Morton (2004) attempted to dissociate themselves from a social or biological deterministic explanation of the causation of dyslexia. The consequences of the initial neurobiological differences are not inevitable. In conditions such as dyslexia, neurobiological factors usually serve as risk factors (Frith, 1997; Morton, 2004). Brain function differs due to a combination of factors: genetic factors, which include predispositions to certain disorders, and environmental influences, such as quality of nutrition, exposure to toxins, and the quality of instruction. For significant learning symptoms (e.g., poor reading, poor phonemic awareness skills) to become apparent at the behavioral level and reach a critical point for diagnosis, the synergy of cognitive and cultural factors is necessary. On the other hand, within the complex brain-cognition-behavior-environment system, there are compensatory factors (e.g., early phonological processing intervention) that can mitigate the consequences at the behavioral level (Frith, 1997; Morton, 2004).

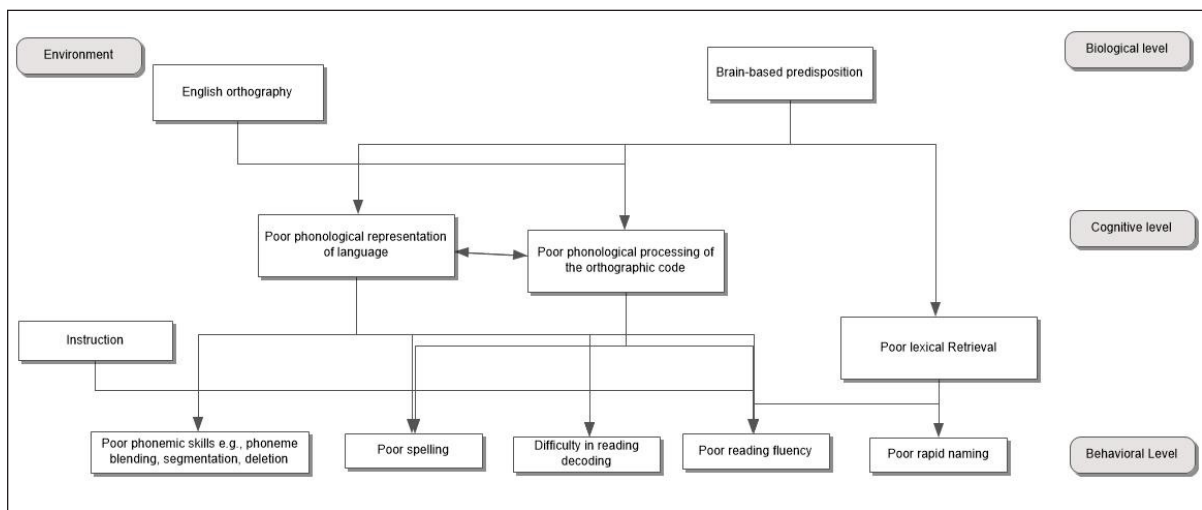
The brain-based susceptibility to dyslexia can lead to a subtle dysfunction in one or multiple cognitive circuits. Determining these circuits is a matter for theoretical frameworks subject to empirical testing (Frith, 1997). In the case of dyslexia, these cognitive circuits interfere with the acquisition of reading and spelling abilities. The cognitive demand involved in learning varies with the intricacy of the writing system in question and the quality of teaching. Cultural tools interact with cognitive processes,

enabling the grapheme-phoneme connections of the alphabet and orthographic knowledge to become entirely automatic (Caravolas et al., 2013; Frith, 1997).

The cognitive deficit (e.g., the accuracy and speed in the phonological processing of the orthographic code) manifests as a distinct pattern of behavioral signs. These signs vary with the child's age, general cognitive capacity, motivation, and cultural factors. The factors that shape the behavioral pattern of signs are within the child and outside, such as instructional conditions (Frith, 1997).

In these causal models, the cognitive level is critical for understanding dyslexia and SLDS. It is also critical for designing interventions that can guide teaching methods (e.g., phonological processing interventions for students with dyslexia and SLDs).

There are two critical differences between Coles's (1987) interactional/constructionist approach and Frith's (1997) and Morton's (2004) interactional/emergentist approaches. First, while Coles primarily emphasizes the deterministic role of social, family, and school conditions in his interactivity theory, Frith and Morton integrate multiple levels of explanation, including biological, cognitive, behavioral, and environmental factors. A second critical difference is the emphasis on the cognitive level in understanding SLDs. Frith (1997) and Morton (2004) stress the importance of focusing on the cognitive level and addressing cognitive deficits when designing individualized interventions for students with SLDs. In contrast, although Coles (1987) acknowledges the importance of cognitive processes in SLDs, his focus is primarily on the interaction between learners and their social environments, emphasizing the importance of modifying



**Figure 1**  
An Emergentist Model for the Double-Deficit Hypothesis of Dyslexia Based on Frith (1997) and Morton (2004)

school expectations and providing adequate support from families to address learning challenges. However, effective science requires a clear recognition of the determining explanation and the determining level at which to intervene (Rose, 1998). Failing this, valuable human resources and ingenuity are wasted, and efforts may be diverted from addressing the genuine challenges confronting science and society.

### **Strong Social Constructionism and SLDs**

The strong version of social constructionism attributes SLDs to social structures, including but not limited to social class, racial dynamics, power relations, cultural norms, social attitudes, and school organization (e.g., Baglieri et al., 2011; Connor et al., 2011; Dudley-Marling, 2004; Finlan, 1994; Reid & Valle, 2004; Skrtic, 1999, 2005; Sleeter, 1986). A significant aspect of Disability Studies in Education (DSE) and Disability Critical Race Theory (DisCrit) is grounded in the strong social constructionist view of disability and SLDs. This perspective posits that SLDs are not individual conditions, neurobiological and cognitive in nature, but products of the social environment and its inherent biases (e.g., Baglieri et al., 2011; Connor et al., 2011; Finlan, 1994; Reid & Valle, 2004). In addition, social constructionists raise questions about the ontological nature of the SLDs and the nature of these conditions as being “real.” For example, Reid and Valle (2004) stated concisely that “learning disabilities are not objective fact; they are historically and culturally determined” (p. 463).

Likewise, Sleeter (1986) provocatively suggested that the concept of SLDs emerged to rationalize the shortcomings of white middle-class children, offering a shield against the stigma of failure. In her words, “... learning disabilities was created to explain the failures of white middle class children in a way that gave some protection from the stigma of failure” (Sleeter, 1986, p. 46). Furthermore, Sleeter (1988) emphasized that the creation of SLDs cannot be simply attributed to the diligent efforts of specific groups advocating for educational categorization. In her own words, “The fact that learning disabilities was a White middle class creation is significant, and cannot be reduced simply to the fact that certain groups worked hard for a certain education category and program, all for the greater good” (Sleeter, 1988, p. 55).

Dudley-Marling (2004) adopted a social constructionist approach by delving into the intricate processes through which SLDs are socially constructed, highlighting the role of language, discourse, and societal norms in shaping perceptions and experiences of disability. Connor and Ferri (2010), in turn, revisited Sleeter’s socio-political analysis of disability, reflect-

ing on the enduring relevance of her insights in understanding the complexities surrounding SLDs.

Skrtic (1999, 2005) considered that schools, because of their bureaucratic structure, resist adapting to the diverse needs of students. Thus, the school system allegedly leads to the creation of institutional categories like special education, which he argued shifts blame for school failure onto students through practices that medicalize and marginalize them. In Skrtic’s (2005, p. 197) words, “Learning disabilities are *organizational pathologies*” (emphasis added). In addition, Skrtic (2005) considered SLDs a socially constructed category like “class, race, gender, ethnicity, sexuality, age, and disability itself” (p. 149).

Gallagher (2004) refuted the reality of SLDs for epistemic and ontological reasons, stating:

... learning disabilities are real implies that they have an objective existence apart from anyone’s pretheoretical dispositions of what constitutes a disability; on the other hand acknowledging that learning disabilities is a concept subject to development suggests that the condition cannot exist apart from one’s beliefs about normal versus abnormal functioning. (pp. 11–12)

Despite how well SLDs have been conceptualized, dyslexia and dyscalculia are not merely conceptual constructs or subjective beliefs; they are real conditions with identifiable characteristics (Peterson et al., 2021). Gallagher (2004) conflated the quality of the conceptualization of SLDs—a correspondence issue between a concept (see learning disabilities) and reality—with her dispositional ontological stance about reality. Dyslexic conditions manifest consistently across different cultural and educational contexts (Paulesu et al., 2001; Peterson & Pennington, 2012; Richlan, 2020; Snowling, 2019). The functional neuroanatomy of dyslexic readers universally shows under-activation in the “reading network” regions of the left hemisphere (Peterson & Pennington, 2012, 2015; Richlan, 2020). While historical conditions and scientific status can influence how dyslexia is conceptualized and treated, the underlying conditions remain the same (Paulesu et al., 2001; Snowling, 2019; Ziegler et al., 2003). Behavioral consistency (reading and spelling difficulties, a significant reading speed deficit, and a pronounced nonword reading deficit greater than the word reading deficit), cognitive consistency (e.g., weaknesses in phonological processing), and consistency in brain activation across languages, orthographies, and cultures support the notion that dyslexia has an objective existence independent of individual or cultural beliefs (Peterson & Pennington, 2012; Peterson et al., 2021; Richlan, 2020; Ziegler et al., 2003).

In addition, the evidence presented by Reis et al. (2020) indicates that dyslexia is a real condition independent of school systems and cultural contexts. Indeed, their meta-analysis demonstrates that reading and writing difficulties persist into adulthood for individuals with dyslexia, regardless of the orthographic depth of the language systems (opaque, intermediate, or transparent). This persistence suggests that dyslexia is not merely a byproduct of specific educational systems or cultural practices but is a condition with universal characteristics. The persistence of dyslexic difficulties into adulthood, despite years of exposure to print and varied educational interventions, emphasizes that dyslexia is not merely an artifact of poor teaching or a lack of learning opportunities. It is a lifelong condition that affects individuals regardless of the educational system or their cultural background.

In Reis et al.'s (2020) meta-analysis, dyslexic adults exhibited greater challenges with speed measures than accuracy measures, particularly in tasks involving word and pseudoword reading, phonological awareness, and orthographic knowledge. These consistent difficulties across various languages support the notion that dyslexia has a universal basis rather than being dependent on school systems or cultural contexts. While orthographic depth, a structural feature, modulates the severity of dyslexic symptoms—with transparent orthographies showing less severe symptoms—the presence of these difficulties across all orthographies reinforces the idea that dyslexia is a universally occurring condition.

Furthermore, the effectiveness of specific interventions and treatments for dyslexia, such as phonological processing interventions, supports its objective reality. Ian Hacking (1983), a philosopher of science, argued that the ability to successfully intervene and manipulate an X phenomenon (in this case, a dyslexic condition) is strong evidence of its reality. The fact that dyslexia can be treated through scientifically validated methods is an indicator of its objective existence. The success of phonological processing interventions, which lead to consistent and predictable improvements in several cultures, languages, and orthographies, further validates the reality of dyslexia.

### **Social Constructionism vs. Social Constructivism: A Critical Distinction**

The terms *social constructionism* and *social constructivism* are often used interchangeably. However, two critical distinctions must be drawn.

First, it is crucial to differentiate between the terms *construct* and *social construction*. In social sciences, a construct is a theoretical concept (e.g., intelli-

gence, motivation, anxiety, phonological processing, disability, and SLDs) created to explain a phenomenon. These constructs are not directly observable but are inferred from behavior patterns, emotions, and thoughts. Conversely, social construction refers to the perspective that reality, or at least some aspects of our world, are not independent of the mind but are perceptions shaped by social and cultural norms. Social construction posits that facts are not merely discovered but are created by human activities and interactions within a society. Facts, according to the social constructionist perspective, reflect the values, interests, and needs of the social group that constructed them (Boghossian, 2006; Hacking, 1999). Unlike the construction of tangible objects in the ordinary sense, *social construction* refers to the creation of facts (Boghossian, 2006). However, specific claims about the social construction of specific phenomena of the natural and social world can be true, partially true, or false.

Second, we need to distinguish between *social constructionism* and *social constructivism*. Social constructivism, grounded in the Vygotskian approach, underscores the significance of social interaction and cultural tools in the acquisition of knowledge. As an educational psychology theory, it focuses on the epistemic aspects of knowledge—how individuals come to know and understand—rather than the ontological nature of reality itself. Social constructivism highlights the importance of social interactions, language, and cultural context; learners actively construct knowledge as they engage with their social environment (Vygotsky, 1978). In practical terms, social constructivism suggests that knowledge acquisition is a collaborative, constructive process (Vygotsky, 1978). It is crucial to emphasize that Vygotsky maintains a realist perspective, acknowledging the existence of an external world and objective reality. He articulates this clearly when he states, “Any investigation explores some sphere of reality” (p. 91). Furthermore, he acknowledges that language somehow corresponds to reality when he claims, “the *planning function of speech* comes into being in addition to the already existing function of language to reflect the external world” (Vygotsky, 1978, p. 28).

Instead, social constructionism is a sociological theory emphasizing the socially constructed nature of reality. Unlike epistemic theories, this theory falls under the domain of ontology, which studies the nature of existence. Social constructionism focuses on how an X phenomenon (ranging from disability to illness, crime, sexuality, and authorship) is a social construction of social norms, institutions, cultural

practices, linguistic transactions, and so on (Anastasiou & Kauffman, 2011, 2013; Hacking, 1999). Hacking (1999) highlighted the extensive and indiscriminate application of the social construction concept and provided a listing of more than 20 phenomena that scholars had claimed to be socially constructed, posing the critical question, “The social construction of what?” This question challenges us to consider the specific aspects and boundaries of what is claimed to be socially constructed, urging a more precise and reflective examination of the concept’s application (Hacking, 1999; Williams, 2017).

Nonetheless, several academics have used social constructionism and social constructivism interchangeably. While this might have minimal consequences in fields outside of education, it is crucial to clearly distinguish between these concepts within the educational context due to their significant practical implications. Furthermore, social constructionism has been an extremely unproductive and barren approach to developing educational methods and technologies. In contrast, social constructivism can be quite fruitful when applied appropriately. To elaborate, although social constructivism is connected to the whole-language approach to reading, which is less effective than phonics, it has also inspired promising strategies for addressing reading comprehension and writing difficulties faced by students with SLDs (Bus & van IJzendoorn, 1999; Ehri et al., 2001b).

One notable example of a practice with potentially positive effects associated with social constructivism (not constructionism) is the Self-Regulation Strategy Development (SRSD) writing model. SRSD draws inspiration from Soviet theorists and researchers like Vygotsky, Luria, and Sokolov, who explored the social origins of self-control and mind development (Harris & Graham, 2009; Harris et al., 2008; What Works Clearinghouse [WWC], 2017). Similarly, Reciprocal Teaching, aimed at enhancing reading comprehension, bears Vygotskian influence, particularly in its emphasis on gradual internalization (Palincsar & Brown, 1984; WWC, 2010). Finally, another promising practice associated with social constructivism is Collaborative Strategic Reading (CSR), an evolution of reciprocal teaching tailored to enhance content area reading skills (Klingner & Vaughn, 1999; WWC, 2013). CSR encourages students to work together in small groups, using strategies such as pre-viewing the text, clicking and clunking (identifying known and unknown information), getting the gist (summarizing), and wrap-up (reviewing key ideas) to improve reading comprehension and content learning across various subjects (Klingner et al., 2012).

A common feature of these three teaching practices—SRSD, reciprocal teaching, and CSR—theoretically linked to constructivism is their emphasis on explicit instruction. These methods involve explicit instruction of strategies for reading or writing and clearly defined roles within small groups. The substantial focus on explicit, systematic instruction and the teacher’s guiding role significantly enhances the effectiveness of these practices in real-world educational settings.

### **Cognitive Relativism and the Rortyan Influence**

Cognitive relativism is an epistemological view that asserts the absence of objective truths. According to this perspective, what is considered true or false is relative to individual or cultural beliefs, perspectives, and contexts (Bunge, 1996, 1999).

Cognitive relativism encompasses a spectrum of views, from moderate to extreme. A moderate version may question the existence of universal truths in the social sciences, suggesting that our knowledge is always influenced by our social and cultural contexts (Brown, 2001; Bunge, 1996, 1999). An extreme version of cognitive relativism contends that *all* knowledge is relative to cultural norms, social groups, and subjective experiences. According to this view, therefore, there are no absolute standards for judging the truth or falsehood of any proposition, and no objective facts exist. Instead, truth for extreme cognitive relativists is always “truth for X,” where X can be a person, group, community, and so on (Brown, 2001; Psillos, 2007). Typically, extreme social construction theorists are cognitive relativists too, because if there is no independent reality—if the entire world is a social construction in the sense of a social myth, then no objective truth can exist (Brown, 2001; Bunge, 1996, 1999).

Several special education scholars have advocated for a perspective reminiscent of Rorty’s cognitive relativist framework. Richard Rorty (1979, 1989, 1991, 1998), a philosopher, developed a controversial brand of pragmatism that significantly departed from the views of classical pragmatists like Charles Sanders Peirce (Haack, 1998, 2009). Rorty (1979, 1989, 1991, 1998) rejected the possibility of objective truth in *both* natural and social sciences. According to Rorty’s viewpoint, while the world may exist independently of human minds, truth emerges as a product of human language and interpretation.

Despite his rhetorical reference to “the world is out there,” Rorty (1989) blurred the distinction between epistemology (how we come to know what exists) and ontology (what exists), reducing natural

and social phenomena to language. Rorty stated that the world is “out there” independent of us but denied that truth is “out there.” However, if a mind-independent world exists, there are objective truths about that world, regardless of whether humans have discovered or expressed them in language.

Rorty (1989) also conflated the possibility of the truth with how language expresses and communicates the truth. In short, Rorty (1979, 1989) argued that (a) representing reality is unattainable; (b) “truths” are created intersubjectively; (c) language is a tool we use to construct our own reality and cope with life; and (d) all knowledge is relative to our language and beliefs. Everything exists within the domain of language and pre-existing beliefs.

Further, Rorty suggested eliminating the concepts of truth-seeking, methodological objectivity, and science, proposing instead focusing on justifying beliefs to audiences as the foundation of knowledge (Rorty, 1999). Rorty and his followers in special education modified the standard definition of knowledge as “true, justified belief” by removing the “true” qualifier. In the Rortyan epistemic approach, a justified belief is sufficient.

In Rorty’s vision (1999), abandoning the pursuit of objective truth leads to a society where dialogue and interpretation are paramount. However, without acknowledging objective truths, we cannot make sense of our knowledge claims or engage in meaningful debate (Boghossian, 2006). That is, when we dismiss objective standards, we lose the ability to critically assess and challenge power structures effectively (Boghossian, 1996, 2006; Brown, 2001). Although cognitive relativism is often linked to liberal causes and part of the academic Left, it paradoxically hampers the progress of these very political objectives. As Brown (2001) succinctly put it: “The Left doesn’t have the money or the guns to get its way. Clear thinking is the Left’s best weapon” (p. 11). Empirical evidence and clear reasoning are necessary to advance social justice and equality. Without a foundation in scientific truth, the left lacks the intellectual rigor to formulate coherent arguments, persuade others, and implement lasting change.

### **Cognitive Relativism and SLDs**

Rorty’s relativism has significantly influenced special education. In this context, cognitive relativism can be characterized by five key theses:

(1) **Cultural Dependence of Scientific Knowledge:** Cognitive relativists assert that human knowledge is culturally constructed and influenced by cultural values and individual beliefs, making objective observation impossible (Gallagher, 2004, 2006; Gallagher et al., 2014).

- (2) **Subjective Construction of Reality:** Cognitive relativists believe that knowledge about the world is subjective and can be deconstructed and reconstructed as needed (Gallagher, 2004, 2006).
- (3) **No Distinction Between Facts and Values:** Cognitive relativists argue that facts and values cannot be separated because observations are always influenced by preexisting theories and interpretations (Gallagher, 2004, 2006). They challenge scientific objectivity, arguing that it is based on an unsustainable separation of facts from values (Gallagher, 1998).
- (4) **Critique of Scientific Methods:** Cognitive relativists criticize the overreliance on scientific methods in special education research, arguing that it overlooks subjective, affective, and contextual aspects (Poplin, 1987).
- (5) **Equal Validity of Ways of Knowing:** Cognitive relativists claim that scientific knowledge is not superior to other ways of knowing (Thorius et al., 2024).

### **Implications for SLDs Research and Practice**

**Radical Skepticism About Evidence-Based Practices (EBPs).** Ferri et al. (2011) and others criticized EBPs, suggesting they fail to account for educational contexts’ complexity and nuanced needs. Ferri et al. (2011) claimed that “EBP is an ideology that fails its own ideology” (p. 224), and Baglieri et al. (2011) questioned the “authoritative status” of EBPs, advocating for diverse research methodologies.

Critics argued against the objectivity of scientific methods. Baglieri et al. (2011) stated that scientific educational research is neither objective nor neutral. Gallagher (2013) noted the dominance of empiricist and positivist methodologies due to mandates for EBPs from the Institute for Educational Sciences and the What Works Clearinghouse. Gallagher (2017) further contended that the complexity of educational settings makes predictive and controlled outcomes unachievable and questions the ideological and political underpinnings of the EBP framework.

Critics misrepresented EBPs as rigid and inflexible (e.g., Connor & Valle, 2015). However, EBPs initiatives call for using the best available evidence to inform decision-making, including adapting practices to fit specific contexts and student needs. Contrary to critics’ portrayal, they emphasize flexibility and responsiveness.

**Teacher Training and Preparation.** Gallagher (2004) created a weird but false dichotomy between using scientific research and fostering sound teaching practices. She contrasted the “empiricist” [*sic*] view of training teachers to use effective technologies

with the constructivist [*sic*] perspective of developing craft knowledge and contextual problem-solving skills (p. 10). However, EBPs can enhance teaching by providing strategies teachers can adapt to their unique classroom contexts.

**Scientific Methods.** Gallagher (2004) reduced scientific methods to a philosophical (empiricist) perspective. By creating a false divide between *empiricism* and *constructivism* (*constructionism* would be the correct term in this context), Gallagher (2004) sought to legitimize her skepticism about EBPs. However, our focus should not be on an irrelevant philosophical debate about the superiority of *empiricism* vs. *constructivism*. Instead, we should concentrate on best preparing special education teachers to use EBPs effectively.

Despite criticisms, scientific techniques—including statistical analysis, peer review, and replication—are designed to minimize biases and enhance reliability. Dismissing the scientific methods and associated techniques undermines the progress achieved in special education through rigorously tested interventions.

### ***A Brief Critique of Cognitive Relativism***

Cognitive relativism in special education challenges the objectivity of scientific knowledge. It equates scientifically validated facts with culturally constructed beliefs, blurring the distinction between objective facts and social constructions (Sokal & Bricmont, 1999). This perspective neglects empirical evidence and the intrinsic methodological rigor of scientific research, unduly focusing on social influences (Kauffman & Sasso, 2006b). As such, cognitive relativism is self-refuting since if all knowledge is socially constructed, then this applies to its own claims, undermining the validity of its claims (Kauffman & Sasso, 2006b).

The notion that all ways of knowing, including non-scientific ones, have “equal validity” undermines our ability to distinguish between rigorous scientific methods and other forms of inquiry and makes it difficult to differentiate between empirical knowledge based on systematic observation and evidence and less reliable forms of knowing, such as anecdotal evidence, intuition, tradition, and revelation or faith (Boghossian, 2006).

By equating all methods of knowing, we risk eroding the credibility and effectiveness of scientific inquiry, which is essential for advancing knowledge. By undermining rigorous scientific inquiry and the possibility of objective truth, including approximate and conditional truths, cognitive relativism undermines the pursuit of evidence-based practices cru-

cial for effective interventions for students with disabilities, including those with SLDs.

Furthermore, cognitive relativism fails to account for the practical success of scientific theories in explaining phenomena such as SLDs. It offers no practical tools for explaining the learning difficulties of students with SLDs, unlike rigorous scientific methods, which, despite their imperfections, remain the best tool for explaining learning phenomena, reducing doubt and uncertainty in an applied scientific field like special education.

### **Neurological Reductionism**

Neurodiversity advocates argue that dyslexia and other neurodevelopmental conditions, such as autism, should be viewed as atypical yet natural variations in brain functioning rather than disorders or impairments that require treatment (Armstrong, 2010, 2012; Singer, 1998, 2017). This perspective introduces the concept of a “neurodivergent” thinking style, contrasting it with most people’s “neurotypical” thinking style.

Judy Singer (1998, 2017), one of the pioneers of neurodiversity, diverged from the social determinism of the social model of disability, criticizing it for what she perceived as its “anti-biological stance” and its tendency to overstate arguments against medical intervention (1998, p. 20).

Unlike the social model, which formed the basis for the foundation of the field of Disability Studies, the neurodiversity movement tends to essentialize conditions like autism and dyslexia as purely neurological in nature, reflecting a strong form of neurological reductionism. Nevertheless, like the social model, neurodiversity emphasizes celebrating identity. Specifically, it emphasizes a neurobiological identity, whereas the social model of disability focuses on a sociological identity. Interesting, there is often a convergence between social determinism and neurological reductionism within the academic field of Disability Studies, resulting in an identitarian approach to addressing disability issues, including those related to learning.

We should recognize the significant advantages of the neurodiversity movement. First, it has promoted the social acceptance of diverse conditions. Second, it has greatly enhanced inclusivity in workplaces and society in general by valuing the unique cognitive strengths of individuals with autism spectrum disorders, for example, fostering a more inclusive environment in universities and workplaces. Third, it has helped individuals develop a positive

self-identity, empowering them to see themselves as fundamentally worthy.

However, the neurodiversity perspective also has notable drawbacks. First, proponents of neurodiversity often emphasize the biological aspects of conditions like autism and dyslexia, arguing that they represent natural variations in neurological functioning. At the same time, however, they tend to overlook the importance of developmental processes during childhood, underestimating the significance of learning during periods of brain plasticity (Kolb & Gibb, 2014; McLaughlin et al., 2019). By neglecting the crucial role of experience in brain development, they miss the potential impact of environmental factors as either mitigating or exacerbating these conditions. For instance, early childhood interventions can significantly influence neural development and alleviate the challenges associated with certain neurodevelopmental conditions (Bortfeld & Bunge, 2024; Kolb & Gibb, 2014; McLaughlin et al., 2019).

Second, neurodiversity proponents often downplay the necessity of specially designed instruction tailored to individual needs (Kauffman et al., 2022). By solely celebrating neurodiversity without considering the role of experience, the neurodiversity movement may inadvertently downplay the importance of specially designed instruction in supporting individuals with neurodevelopmental differences (Kauffman et al., 2022).

Third, neurodiversity has significant implications for explaining and understanding neurodevelopmental conditions. Overlooking the role of experience in shaping neural pathways is a reductionist perspective that ignores the complex interplay between biology and environment in determining outcomes for individuals with these conditions (Bortfeld & Bunge, 2024; Kolb & Gibb, 2014; McLaughlin et al., 2019).

## Political Conformism

Political conformism, defined as ruling certain scientific questions “out of bounds” simply because they offend political sensibilities, has impacted areas of special education research. It occurs when researchers avoid properly exploring specific topics or issues due to concerns about the dominant political climate or the fear of being perceived as politically dissident (Lilienfeld, 2010). One notable example of political conformism in special education is the ongoing debate surrounding the disproportionality of minorities in disability rates, including SLDs rates and special education placements (Morgan & Farkas, 2016; Skiba et al., 2016).

Political conformism can lead to dismissing or suppressing research findings that challenge prevailing assumptions or policy positions. For example, studies indicating the underrepresentation of minority students in special education, including those with SLDs (Morgan et al., 2015, 2017b), have faced unjustified criticism from those who believe these findings undermine the goal of educational equity (Anastasiou et al., 2017; Kauffman & Anastasiou, 2019). This can create a chilling effect, discouraging researchers from pursuing lines of inquiry that may be perceived as politically controversial or unpopular.

The topic of disproportionality has often been met with political conformism, as it touches upon sensitive issues related to race, discrimination, and educational equity (Anastasiou et al., 2017; Kauffman & Anastasiou, 2019; Sullivan & Proctor, 2016). Some researchers may be hesitant to explore the root causes of disproportionality, fearing that they might be accused of promoting racial stereotypes. As a result, politically charged explanations for disproportionality, such as bias in referral and assessment processes (Skiba et al., 2008), are emphasized over other potential factors, such as socioeconomic disadvantage and school performance, despite the best evidence available (Morgan et al., 2015, 2017a, b).

To counter the effects of political conformism, the special education community must foster a culture of open and honest dialogue where researchers feel empowered to ask difficult questions, challenge assumptions, and explore alternative perspectives without fear of political reprisal. This, in turn, requires a commitment to scientific integrity, intellectual openness, and a willingness to engage in constructive debate and critical self-reflection. By fostering a space for diverse viewpoints and rigorous scientific inquiry, the field of special education can achieve a more nuanced understanding of complex issues like disproportionality. This approach can help develop evidence-informed policies that promote educational equity and excellence for students from diverse social and cultural backgrounds.

## Educational Fads and Non-Scientific Interventions

Educational fads and pseudoscientific claims have long plagued the field of SLDs, diverting attention and resources from EBPs (Cook & Cook, 2020). Often fad “therapies” are rapidly adopted despite little validating research, gain wide use, and then fade, usually in the face of disconfirming evidence (Vyse, 2016). In addition, some interventions for students

with SLDs continue to be used despite a lack of supporting evidence.

One prominent example of a non-scientific intervention is learning styles. The speculative “theory” of learning styles is based on unsupported claims that (a) each student has a distinct learning style (e.g., visual, auditory, kinesthetic), and (b) instruction should be tailored to match these specific learning styles (Dunn, 1983; Dunn & Dunn, 1979). Dunn’s influential 1983 article on learning styles was published in *Exceptional Children*, a prominent special education journal, in which she described her model for assessing and establishing learning styles for gifted and underachieving exceptional students (see Landrum & McDuffie, 2010, for details).

Nevertheless, a comprehensive review by Pashler et al. (2008) found no scientific evidence to support Dunn’s claims. In their words, “there is no adequate evidence base to justify incorporating learning styles assessments into general educational practice” (Pashler et al., 2008, p. 105). Similarly, in a systematic review of research on learning styles conducted since 2009, Cuevas (2015) found that methodologically rigorous studies tended to refute the learning styles hypothesis while revealing the existence of a substantial divide. Learning style instruction enjoys broad acceptance in practice, but much research suggests that “it has no benefit to student learning, deepening questions about its validity” (Cuevas, 2015, p. 308). Furthermore, the author concluded that “the learning styles hypothesis has been refuted by empirical research to the extent that it may be considered irresponsible for teacher education programs and public educators to apply the method in practice” (Cuevas, 2015, p. 330). Despite its widespread popularity and acceptance among educators, there is a lack of empirical evidence supporting the efficacy of differentiated instruction tailored to learning styles. Therefore, Landrum and McDuffie (2010) advised against differentiating instruction based on students’ purported learning style preferences.

### ***Universal Design for Learning (UDL)***

The UDL framework suggests the importance of providing multiple alternative methods for instructing material, aiming to enhance the accessibility of learning. However, this approach encounters a challenge when juxtaposed with cognitive load theory. According to cognitive load theory, multiple instructional methods do not always yield positive outcomes. Our working memory, responsible for encoding, organizing, and storing information, has finite capacity (Sweller, 2011; Sweller et al., 2019). When

presented with too much information in various formats, therefore, working memory can overload, hindering effective learning (Sweller, 2011; Sweller et al., 2019). The capacity of our working memory is impacted not only by the intrinsic complexity of the learning task but also by the extraneous cognitive load associated with the redundant or untimely presentation of instructional material. This extraneous processing load can significantly impede learning outcomes (Sweller et al., 1998; Van Merriënboer & Sweller, 2005).

In addition, UDL presents a challenge, particularly regarding its applicability to *all* students, including those with disabilities. The question arises: Is UDL truly appropriate for all, in a literal sense, even for literally *all* learners with disabilities? Critiques have questioned the extent to which UDL accommodates the special educational needs faced by literally *all* students with disabilities.

### ***Other Non-Scientific Interventions***

Colored lenses and overlays have been used to alleviate visual stress in students with dyslexia. While colored lenses or cheaper alternatives like colored overlays or adjusting computer screen settings can provide short-term relief, these methods’ impact on reading has not been rigorously evaluated (Snowling, 2019).

Another popular intervention is auditory integration therapy (AIT), including the Tomatis Method, which involves having individuals with dyslexia, SLDs, and autism listen to modulated music to improve auditory processing and alleviate difficulties (Zane, 2016). There is no evidence of effectiveness; indeed, professional organizations like the American Speech-Language-Hearing Association (ASHA), American Academy of Audiology, and Educational Audiology Association have stated that AIT violates ethical codes, is unsupported, and may cause harm to a child’s auditory system (Zane, 2016).

Dietary supplements, such as omega-3 fish oil, have also gained popularity as interventions for dyslexia. However, limited evidence from controlled evaluations supports this approach, particularly for dyslexia (Snowling, 2019).

Parents and educators understandably seek quick remedies for students struggling with SLDs, making them vulnerable to the promises of faddish interventions marketed as miraculous cures. However, these magic-bullet programs typically lack empirical support and often prove ineffective or harmful (Travers, 2017).

Another factor contributing to the popularity of non-scientific interventions is the strong ideological



support these alternatives often receive (Vyse, 2016), despite evidence to the contrary. For instance, the National Reading Panel (2000) found that students benefit more from explicit, systematic phonics instruction than whole-language reading approaches. Similarly, a meta-analysis by Ehri et al. (2001a) confirmed that systematic phonics instruction was more effective than whole-language methods. Despite this evidence, whole-language derivatives, often rebranded as “balanced literacy,” continue to be popular (Moats, 2000, 2007). This persistence is largely due to their alignment with a cherished “child-centered” or “constructivist” philosophical movement, even though they lack empirical support for their effectiveness. This ideological adherence overshadows scientific findings, leading to the continued use of less effective educational practices (Moats, 2000, 2007).

### The Purpose of Research in SLDs

The overall Telos (purpose) of special education is to provide specially designed instruction (SDI) to students with disabilities, aiming to address the adverse effects of their disability on learning and maximize their overall functioning (Anastasiou & Kauffman, 2019; Anastasiou, Burke, et al., 2024). The fundamental concept guiding special education is encapsulated in the formula: *disability + severe learning gap = need for specialized instruction* (Anastasiou, Burke, et al., 2024). This formula centers primarily on addressing the identified learning gap. Thus, the U.S. federal special education law explicitly emphasizes that the main purpose of special education is to provide SDI (Anastasiou, Burke, et al., 2024). However, for many, the established usage of the “special education” concept includes more than just SDI. It also brings to mind special education settings, relevant legislation, and special education teachers. Additionally, special education is considered a relatively distinct research domain within academic contexts. Therefore, the tripartition of special education into research, system, and SDI aligns today more effectively with its varied functions, offering a more nuanced approach than other distinctions, such as those between theory and practice or between research and practice (Anastasiou, Burke, et al., 2024).

Is special education’s purpose the same for each function? Anastasiou, Burke, et al. (2024) argued that the Telos for SDI aims to optimize learning for students with disabilities. The purpose of the special education subsystem embedded into the national education system is equality of opportunity and social justice. Finally, the purpose of special education and related research is truth-seeking.

The following discussion will focus on the primary Telos of research: truth-seeking. As in other factual sciences, research in special education and SLDs aims to discover or approximate truth and increase the knowledge base (Bunge, 2017). Research endeavors in SLDs aim to uncover new truths, including innovative applied interventions. In alignment with this purpose, technology is pivotal in developing practical technological tools (Bunge, 2017). Empirical evidence is the cornerstone for establishing truth, whereas empirical refutation indicates falsehood (Bunge, 2017).

However, some philosophers, embracing extreme cognitive relativism, have challenged this truth-seeking goal, arguing that scientific facts are socially constructed rather than discovered (Anastasiou & Kauffman, 2013; Kauffman & Sasso, 2006a, b). For instance, Latour and Woolgar (1986) claimed that scientists create facts through inscription devices, language transactions, and social interactions. But this view overlooks the robust methodologies and empirical evidence that underpin scientific inquiry. Scientific facts are derived from rigorous, repeatable experiments and observations that yield consistent results across different contexts and by different researchers.

While social and political forces influence science, distinguishing between these influences and asserting that all scientific evidence is socially constructed is crucial (Anastasiou, 2018; Anastasiou, Burke, et al., 2024). Social factors can shape research agendas and ethical boundaries but cannot arbitrarily create scientific facts divorced from external reality (Anastasiou, Burke, et al., 2024; Bunge, 1999). Scientific findings undergo constant scrutiny through self-corrective methods to ensure their truth and falsity (Bunge, 1983; Merton, 1973; Sellars, 1963/1991). Although the self-corrective nature of science does not address all biases or ethical issues, it highlights the importance of seeking truth in scientific inquiry (Niiniluoto, 1999).

In factual sciences (unlike in arts, literature, ethics, or theology), truth encompasses two concepts:

- (a) *Truth-seeking*, which is an epistemic value (Anastasiou, Burke, et al., 2024; Bunge, 1996).
- (b) *Truth* itself, which is a semantic concept. Factual truth is the correspondence of propositions to reality (Bunge, 2012; Niiniluoto, 1999; Psillos, 1999). Truth comes in degrees. The *degree of truth* concept is fundamental to scientific inquiry, as it acknowledges the inherent uncertainty and fallibility of our understanding of the natural and social world (Bunge, 1974, 1983, 1996). This concept recognizes that our knowledge of reality

is always provisional, and theories are constantly subject to refinement or revision as new data become available (Bunge, 1996). *Approximate truth* is a related concept that acknowledges that our theories may not perfectly capture the complexities of reality. Instead, they provide an abstract representation of the phenomena we observe. Despite their limitations, these approximations are incredibly useful for making predictions, designing experiments, constructing research hypotheses, and guiding our explanation of the social world (Bunge, 1996; Haack, 2009). Questioning the accuracy of a proposition presupposes a truth valuation, suggesting that there are values of truth (or falsity) beyond “absolutely true” and “absolutely false” (Bunge, 2012).

In science, a hypothesis is not evaluated against mere facts but by examining empirical data linked to it (Bunge, 1983). Truth can be *partial*, *approximate*, or *conditional*; empirical evidence may be incomplete or uncertain, leading to an approximate explanation of phenomena. This is particularly true when dealing with complex social systems or phenomena that are difficult to fully explain, understand, or model (Bunge, 1996; Haack, 2009).

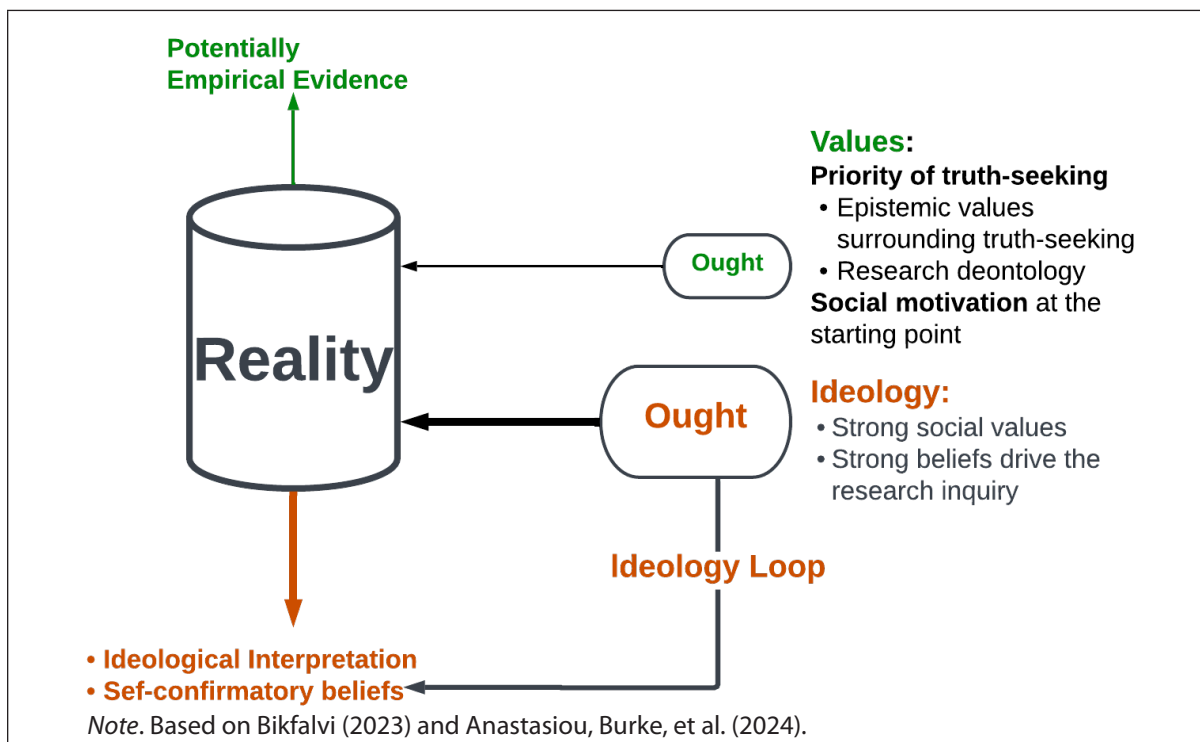
It has been said that values and ideologies (hypertrophic values) are like the air we breathe. Acknowledging this when conducting scientific research is

crucial to avoid oversimplification. Values represent the “ought” in David Hume’s classic distinction between “is” (reality) and “ought.” Hume (1740/2009) distinguished between descriptive or positive statements about what exists (“is” statements) and prescriptive or normative statements about what should exist (“ought” statements).

This “is-ought” issue is closely related to the distinction between facts and values (Putnam, 1981). Research involves two kinds of values:

**Epistemic values:** These include truth-seeking and the values encompassed in research deontology (Anastasiou, Burke, et al., 2024; Psillos, 2015). Research deontology consists of a set of principles and values, such as respect for persons, beneficence and non-maleficence, confidentiality, fairness in recognizing publication contributions, honesty and avoidance of data fabrication, integrity in reporting data, transparency, and social responsibility (American Psychological Association, 2022; Beauchamp & Childress, 2019; Belmont Report, 1979; Miguel et al., 2014; Resnik & Master, 2011; Shamoo & Resnik, 2022).

**Social values:** These can either be a social motivation at the start of research (a minor “ought”) or strong social values driving the research



**Figure 2**  
Reality and Values in Conducting Research

throughout (a strong “ought” or ideology), including findings (Niiniluoto, 1999; Psillos, 2015).

The goal of scientific research must be to discover what truly exists. Although values may motivate research, they should not influence findings (Bunge, 1996). While values are pervasive and can influence interpretations, truth-seeking must be the highest value guiding scientific inquiry (Bunge, 1996). This pursuit of truth must be balanced with deontological principles to ensure research is conducted ethically, minimizing harm and ensuring equitable treatment.

When the “ought” becomes hypertrophic (ideology), it can distort reality by projecting rigid, self-confirmatory beliefs and myside bias (Stanovich, 2021). This creates a closed circuit, an ideological loop, where research findings are difficult to refute, and researchers’ social values cannot challenge hypotheses, leading to a narrow, dogmatic, and inflexible worldview (Bunge, 1996). Ideology can distort research by prioritizing belief-confirming outcomes over truth-seeking (see Figure 2).

Scientific research is built on the premise of an external, mind-independent reality that can be approached through empirical methods and self-correction (Bunge, 1996; Niiniluoto, 1999; Psillos, 1999, 2017). While absolute truths in social science may not be feasible, partial or approximate truths are attainable. Theories provide frameworks for explaining and predicting phenomena but are subject to modification or rejection with new evidence.

In summary, truth-seeking, despite its challenges, remains the core objective of scientific research in special education. This involves balancing the pursuit of truth with adherence to ethical principles, ensuring that research is both rigorous and responsible.

## Progress Despite the Challenges

Despite the constitutional, internal, and external challenges, the field of SLDs has made some hard-won progress. Incremental advancements have been made in research, assessment tools (e.g., curriculum-based measurement), and intervention strategies (e.g., phonological approaches to reading decoding). Here are some notable but not exhaustive, promising, or evidence-based practices organized by intervention area.

### *Phonemic Awareness Instruction*

At least three meta-analyses have shown that systematic phonemic awareness instruction benefits typically developing children, those at risk, and students with reading disabilities. It is effective for preschoolers, kindergartners, first graders, and children

from various socioeconomic backgrounds, including low and middle-high statuses (Bus & van IJzendoorn, 1999; Ehri et al., 2001b). In addition, research indicates that phonemic awareness instruction has a moderate lasting impact on reading and spelling abilities. Suggate’s (2016) meta-analysis demonstrated that the instructional effects are well-maintained over time, with an overall effect size of 0.48 for reading skills and 0.50 for spelling at follow-up.

### *Phonics Instruction*

At least two meta-analyses have shown that systematic phonics instruction effectively improved early reading skills for beginning readers and prevents and remediated reading difficulties for students with SLDs. It outperformed all forms of control group instruction, including whole-language approaches (Ehri et al., 2001a). Systematic phonics instruction was also an effective intervention for teaching decoding skills to students with intellectual disabilities (Dessement et al., 2019).

### *Reading Fluency*

Two meta-analyses have indicated that repeated readings at the instructional level, combined with error correction, performance feedback, and peer-mediated instruction, can improve reading fluency, especially for students with SLDs (Burns, 2024; Strickland et al., 2013).

### *Vocabulary Instruction*

Strategies such as explicit vocabulary instruction, morphological analysis of the word parts, mnemonics, the Frayer model, examples and non-examples, and concept maps can enhance vocabulary development. A meta-analysis by Kaldenberg et al. (2015) found that reading comprehension interventions for students with SLDs in science education significantly improved outcomes, with an overall mean effect size of 0.98. Explicit vocabulary instruction was particularly effective, showing a high effect size of 1.25, while multicomponent interventions had a medium effect size of 0.64.

Goodwin and Ahn (2010) found in their meta-analysis that morphological instruction had a small positive effect ( $d = 0.40$ ) on vocabulary development and was particularly beneficial for struggling readers, students with speech and language disabilities, and English language learners.

Additionally, a meta-analysis by Stahl and Fairbanks (1986) showed that the mnemonic keyword method was particularly effective for definitional vocabulary. This finding was further supported by a research synthesis by Scruggs and Mastropieri (2000).

Further, a recent meta-analysis by Anastasiou, Bagos, et al. (2024) found that concept maps significantly enhanced science achievement among elementary and secondary students, with a moderate overall effect size ( $g = 0.776$ ). This effect was large for low-achieving students ( $g = 2.019$ ;  $k = 5$ ).

### **Reading Comprehension**

Mnemonic keyword methods are particularly effective for recall and sentence comprehension (Stahl & Fairbanks, 1986). A meta-analysis conducted by Rosenshine and Meister's (1994) meta-analysis found that reciprocal teaching significantly improved reading comprehension, particularly when assessed with experimenter-developed tests. The effectiveness of reciprocal teaching was enhanced by high-quality instruction and structured dialogue between teachers and students.

A meta-analysis by Okkinga et al. (2018) on reading-strategy interventions, which included strategies used in reciprocal teaching and collaborative strategic reading (predicting, activating prior knowledge, questioning, clarifying, summarizing, visualizing, using text structure, inferencing, and repairing comprehension), found a small effect size for researcher-developed tests ( $d = 0.431$ ). However, reading-strategy interventions were more effective in Grades 6–8 ( $d = 0.618$ ), particularly for low-achieving students ( $d = 1.115$ ).

### **Writing**

A meta-analysis by Losinski et al. (2014) found that Self-Regulated Strategy Development (SRSD) significantly improves the writing skills of students with emotional and behavioral disorders, demonstrating large effect sizes for essay elements ( $g = 1.687$ ), essay quality ( $g = 1.789$ ), and word count ( $g = 1.127$ ). Results showed that SRSD is an effective strategy for writing, highlighting its effectiveness across various contexts and student demographics.

### **Mathematics**

A meta-analysis by Carbonneau et al. (2013) found that using concrete manipulatives in math instruction led to small to moderate improvements in learning outcomes, with effect sizes of  $d = 0.59$  for retention and  $d = 0.46$  for problem-solving. High instructional guidance led to a larger effect size ( $d = 0.90$ ) than low guidance ( $d = 0.19$ ).

Results of a meta-analysis by Kroesbergen and Van Luit (2003) showed that mathematics interventions for elementary students with special educational needs were most effective in improving basic skills ( $d = 1.14$ ), followed by problem-solving strategies ( $d$

$= 0.63$ ). Direct instruction ( $d = 0.91$ ) and self-instruction ( $d = 1.45$ ) were more effective than mediated instruction ( $d = 0.34$ ).

Another meta-analysis by Jitendra et al. (2018) found that mathematical interventions for secondary students with SLDs and mathematics difficulties (MD) positively impacted student outcomes, with an overall effect size of  $g = 0.37$ . Interventions were more effective for students with SLDs ( $g = 0.50$ ) than those with MD ( $g = 0.14$ ). These mathematical interventions included visual models, cognitive strategies, the Concrete-Representational-Abstract approach, computer-based modules, problem-based learning, and peer-assisted learning.

Finally, a recent meta-analysis by Barbieri et al. (2023) showed that worked examples significantly improved mathematics performance, with an average effect size of  $g = 0.48$ . They were most effective during both practice and initial skill acquisition phases, with correct examples yielding better outcomes than incorrect or combined examples.

### **Formative Evaluation and Curriculum-Based Measurement (CBM)**

A meta-analysis by Fuchs and Fuchs (1986) showed that systematic formative evaluation significantly improved student achievement in special education settings, with an average effect size of 0.70. Graphing the data yielded better results (average effect size of 0.70) than simply recording the data (average effect size of 0.26). Additionally, using data-evaluation rules led to higher improvements (average effect size of 0.91) than relying solely on teacher judgment (average effect size of 0.42) (Fuchs & Fuchs, 1986).

Furthermore, Williams (2014) demonstrated that CBM significantly improved student achievement in mathematics, especially when detailed feedback was included, with a medium effect size of  $g = 0.69$  for computation skills using correct digits as a unit of measurement. Including detailed feedback in CBM interventions for students in special education settings resulted in a medium effect size of  $g = 0.64$ . For overall mathematics performance, detailed feedback yielded a small effect size of  $g = 0.22$ . Williams's study underscored the effectiveness of CBM, particularly when combined with detailed feedback.

Beyond discovering effective interventions, progress in applied scientific fields involves gaining a deeper understanding of phenomena. For instance, considerable advances have been made in understanding dyslexia. Initially, dyslexia was thought to stem from visual perception issues. Today, we have moved from early theories of visual perception is-

sues to the phonological hypothesis. Contemporary refinements of this hypothesis have further clarified the nature of dyslexia, leading to more effective educational interventions.

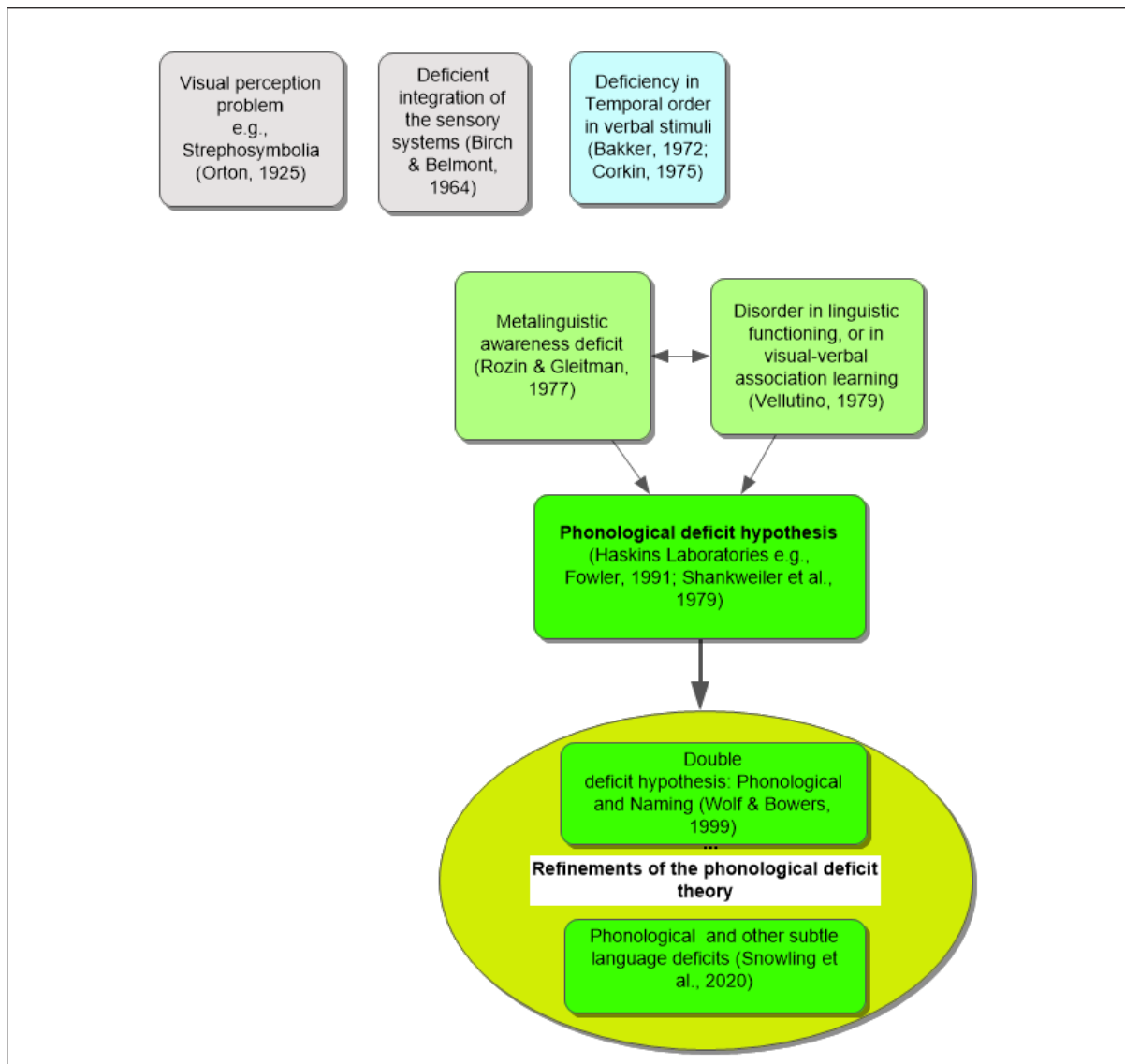
### Closer to Truth

The evolution of our understanding of dyslexia provides a compelling illustration of how scientific development brings us closer to truth. Initially, dyslexia was thought to be primarily a visual perception issue. Figure 3 provides a historical overview of various hypotheses and theories that have been proposed to explain the cognitive causes of dyslexia. As such, it highlights the progression from early theories

to more contemporary understandings, emphasizing the refinement and evolution of these ideas.

Early theories suggested that dyslexia was caused by issues with visual perception, specifically a condition termed *strophosymbolia* (Orton, 1925, 1937), in which individuals purportedly had trouble distinguishing letters and symbols (Kirby & Snowling, 2022; Snowling, 2019). Later, Birch and Belmont (1964) suggested that dyslexia resulted from a failure to integrate sensory inputs effectively whereas Bakker (1972) and Corkin (1975) argued that dyslexia was due to difficulties in processing the temporal order of verbal stimuli, affecting the ability to sequence sounds correctly.

The idea that dyslexia is primarily related to difficulties in language processing emerged in the 1970s.



**Figure 3**  
Cognitive Causes of Dyslexia: Closer to Truth

For instance, Rozin and Gleitman (1977) introduced the hypothesis of a metalinguistic awareness deficit, suggesting that dyslexia involves problems with metalinguistic awareness or the ability to think about and manipulate language components. Similarly, Vellutino (1979) proposed that dyslexia is related to broader linguistic processing issues or difficulties with visual-verbal association learning.

The phonological deficit theory/hypothesis (PDT/H), developed by researchers at Haskins Laboratories (Fowler, 1991; Shankweiler et al., 1979), marked a significant shift by proposing that dyslexia primarily stems from deficits in phonological processing as evidenced by research (Landerl et al., 2019; Share, 2021; Snowling, 2019).

The double-deficit hypothesis (Wolf & Bowers, 1999) expanded this theory by suggesting that dyslexia involves two core deficits: phonological processing and naming speed or rapid automatized naming.

Contemporary research has further refined the phonological deficit theory. Recent empirical studies have illuminated multiple deficits within the broader language domain that, when accumulated to a certain threshold, contribute to dyslexia identification (Kirby & Snowling, 2022; Moll et al., 2020; Peterson & Pennington, 2012, 2015; Ramus & Ahissar, 2012). This includes recognizing that dyslexia may involve various language processing issues beyond phonological processing, which is apparent in early childhood (Snowling et al., 2020).

While the PDT/H does not fully explain reading and spelling difficulties for all students with dyslexia, it represents a pivotal shift in the field. By shifting the focus from visual explanations to language-level factors and interventions, the PDT/H has propelled the field closer to the truth – acknowledging that this is a partial truth rather than an absolute truth.

In addition, the PDT/H has played a pivotal role in enhancing assessments and interventions targeted at the phonological-processing level, particularly in phonemic awareness and phonics. These advancements have benefitted numerous students grappling with reading disabilities (Bus & van IJzendoorn, 1999; Ehri et al., 2001a, b; Stanovich, 2000). Notably, these developments were not the product of mere chance, intuition, or hopeful speculation. Instead, they emerged as a direct outcome of rigorous scientific inquiry.

### **Advancing, Valuing, and Defending Science**

Like the other social sciences (economics, psychology, sociology, anthropology, history, and political science), special education should aspire to be more

scientific. However, we often struggle due to the three kinds of challenges we have analyzed here. In addition, McIntyre (2020) identified some problems in the contemporary status of social science research that are also relevant to special education and SLDs research:

**Overemphasis on theory.** Many studies propose theories without adequately testing them against empirical evidence.

**Ideological bias.** This issue is widespread in the social sciences, particularly with regard to politically sensitive topics. When researchers have preconceived conclusions, they may find evidence supporting those conclusions.

**Cherry-picking data.** Researchers may selectively use data to support preconceived conclusions.

**Questionable causation.** Confusion between correlation and causation is common (McIntyre, 2020).

McIntyre (2020) underscored the transformative power of the scientific attitude, using the historical evolution of medicine as an example, and concluded that a similar attitude in the social sciences could enhance their rigor and reliability. Making SLDs more rigorous and scientific is not just a methodological issue but also an epistemic issue because it requires embracing a scientific attitude toward empirical evidence (McIntyre, 2020).

Methodological plurality is necessary (Cook & Cook, 2026). We need an empirical and open-minded approach to inquiry, regardless of the specific methods used (group designs, single-subject designs, or qualitative methods). Methodological monism ignores the unique complexities and challenges of studying human behavior (Cook & Cook, 2016; McIntyre, 2020). However, methodological diversity should be combined with a commitment to (a) testing theories against empirical evidence, (b) an openness to unexpected findings that challenge preconceptions, and (c) critical scrutiny. This scientific attitude is crucial for any field that aspires to be scientific, ensuring that empirical evidence remains the cornerstone of inquiry (McIntyre, 2020).

The special education field's reluctance to engage in theoretical discussions—similar to those in physics, medicine, and evolutionary biology during their emergent and less mature phases—reveals significant weaknesses. The misguided belief that avoiding these discussions will eliminate potential dangers highlights the field's failure to effectively advocate for its own survival. Avoiding the ostrich effect, wherein the reputation of a scientific field declines while its practitioners bury their heads in the sand, necessitates a proactive approach.

Burnham's (1987) analysis underscored the importance of embracing a defensive program within science—a concerted effort to combat error and uphold scientific integrity. Historically, the defensive program thrived during the 19th century, guided by the belief that scientific endeavors should be not only empirically grounded but also *rational* and socially beneficial. However, as the 20th century progressed, the influence of mass media, and in today's context, social media, coupled with the rise of university clientelism and funding opportunism, contributed to the attenuation of this defensive program.

The proponents of a scientific outlook in the 19th century operated under the assumption that their work served not only empirical ends but also broader societal interests. However, contemporary attitudes have shifted (Burnham, 1987; McIntyre, 2020). A sense of positivism—a philosophy rooted in data-driven inquiry and phenomenalism (the belief that human knowledge is limited to appearances perceived through the senses)—unjustifiably lingers. Meanwhile, there has been a noticeable decline in the fervor to defend science as a societal imperative.

It is imperative to revive and strengthen the defensive program to counteract the erosion of scientific rigor and integrity. This entails a renewed commitment to identifying and rectifying errors, prioritizing rationality and societal benefit over narrow interests (McIntyre, 2020; Settle, 1971). Additionally, fostering a culture of transparency, accountability, and open dialogue within scientific communities can help safeguard against the detrimental effects of misinformation and radical skepticism (Bunge, 1996). Ultimately, by embracing the principles of the defensive program and reaffirming the societal importance of scientific inquiry, we can ensure that science continues to serve as a beacon of knowledge and progress for future generations. It is time to consider a comprehensive approach that embraces scientific attitude, empirical evidence, and critical rationality beyond a narrow data-loving approach.

The field currently grapples with a dearth of comprehensive and cohesive answers, leading to a glaring gap between research findings and practical applications. One significant contributing factor to this disparity is the limited training in empirical methods among special educators. Instead of relying on rigorous research methodologies, many educators find themselves ensnared within the ideological loop, wherein predetermined beliefs and ideologies dictate their understanding of disability and special education (see Figure 2). Within this loop, a singular perspective (e.g., DisCrit) is often touted as capable of

explaining all facets of special education, presenting itself as a seemingly solid approach. However, such simplistic ideological tools for explanation overlook the inherent complexities within the field.

Special education research seems fragmented, with disparate findings failing to coalesce into a unified framework for practice. The dearth of scientific training among educators exacerbates this issue, perpetuating reliance on ideological interpretations rather than evidence-based approaches. To bridge the gap between research and practice, there is a pressing need to transcend the confines of the ideological loop and embrace a multidimensional approach. This entails prioritizing empirical methods and fostering a culture of critical rationality and evidence-based decision-making among special educators. By expanding the toolkit beyond a single perspective and embracing diverse methodologies, SLDs research can offer more comprehensive and nuanced insights into a complex education landscape.

## Implications for Policy and Practice

Overall, the field of SLDs continues to evolve, driven by scientific research, empirical evidence, and evidence-based practices. These efforts can enhance educational outcomes for students with SLDs and contribute to a deeper understanding of their complex conditions. The journey toward establishing SLDs as a well-defined and consistently effective field remains ongoing, with persistent obstacles to overcome and lessons learned from past missteps.

Addressing constitutional and internal challenges will require a sustained commitment to scientific inquiry, evidence-based practices, and critical rationality. By working towards a more stable and scientifically grounded foundation, the field of SLDs can make meaningful progress in supporting the needs of students with SLDs.

By addressing broader external challenges stemming from ideological divides, philosophical tensions, and socio-cultural forces, the field of SLDs can better navigate the complex landscape and create an environment more conducive to EBPs and positive outcomes for individuals with SLDs. Prioritizing EBPs is crucial, particularly in special education, where effective interventions can significantly impact student outcomes. As such, there is a pressing need to integrate EBPs into policy decision-making processes to ensure that research-backed strategies inform educational initiatives.

A critical aspect of implementing EBPs lies in teacher preparation. Teacher preparation programs

have traditionally provided candidate teachers with content knowledge, instructional strategies, pedagogical skills, and clinical field experience. However, with the growing emphasis on EBPs, there is a need to rethink teacher preparation models.

One promising approach for preparing special education teachers is to adopt a practitioner-researcher model. This model integrates research training into teacher preparation programs, empowering educators to critically engage with scientific thinking, research literature, evaluate studies, and implement research-based interventions in their classrooms. By equipping teachers with the skills to understand and apply research findings, we can enhance the quality of instruction and improve student outcomes. This approach fosters a deeper understanding of effective educational strategies and promotes a culture of continuous improvement and EBPs in special education. Ultimately, a practitioner-researcher model not only prepares teachers to be effective practitioners but also enables them to contribute to the ongoing development and refinement of educational practices through scientific thinking.

Adoption of a practitioner-researcher model has several policy implications:

1. **Teacher Preparation Curricula.** Teacher preparation programs should incorporate coursework and training on scientific thinking and EBPs. This will provide teachers with the knowledge and skills to evaluate research literature and effectively and critically apply evidence-based interventions.
2. **Professional Development Initiatives.** Professional development programs should prioritize ongoing training and support for teachers in navigating the evolving landscape of open science. This includes providing opportunities for educators to stay current with the latest research findings and fostering collaboration and knowledge-sharing within professional learning communities.
3. **Coordination of Preservice Education and Professional Development.** There is a need for greater coordination between initial teacher education programs and continuing professional development efforts. Seamless integration of these components ensures that teachers receive consistent and comprehensive training in scientific thinking and EBPs throughout their careers.
4. **Integration Into Standards.** The Council for Exceptional Children (CEC) and state professional teaching standards should incorporate scientific thinking and evidence-based training into both initial special education teacher preparation and ongoing professional development initiatives.

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