# Introduction to Learning Disabilities

Week 2 – 10.19.2015

10.20. 2015

- Note; The four diagnostic criteria are to be met based on a clinical synthesis of the individual's history (developmental, medical, family, educational), school reports, and psychoeducational assessment.

# Specifiers

- Coding note: Specify all academic domains and subskills that are impaired. When more
- than one domain is impaired, each one should be coded individually according to the following
- specifiers.
- Specify if:
- 315.00 (F81.0) With impairment in reading:
- Word reading accuracy
- Reading rate or fluency
- Reading comprehension
- Note: Dyslexia is an alternative term used to refer to a pattern of learning difficulties
- characterized by problems with accurate or fluent word recognition, poor decoding,
- and poor spelling abilities. If dyslexia is used to specify this particular pattern of difficulties,
- it is important also to specify any additional difficulties that are present,
- such as difficulties with reading comprehension or math reasoning.
- 315.2 (F81.81) Witli impairment in written expression:
- Spelling accuracy
- Grammar and punctuation accuracy
- Clarity or organization of written expression

- 315.1 (FBI .2) With impairment in mathematics:
- Number sense
- Memorization of arithmetic facts
- Accurate or fluent calculation
- Accurate math reasoning
- Note: Dyscalculia is an altemative term used to refer to a pattern of difficulties characterized
- by problems processing numerical information, learning arithmetic facts,
- and performing accurate or fluent calculations. If dyscalculia is used to specify this
- particular pattern of mathematic difficulties, it is important also to specify any additional
- difficulties that are present, such as difficulties with math reasoning or word reasoning
- accuracy.

# ICD-10

Tab. 1 ICD -10 (2010)
(http://apps.who.int/classification/icd10/browse/2010/en#/F80-F89)

F81.0 reading disorder

F81.1 spelling disorder

F 81.2 Arithmetic disorder

F81.8 writing disorder

# Severity

- Specify current severity:
- Mild: Some difficulties learning skills in one or two academic domains, but of mild enough
- severity that the individual may be able to compensate or function well when provided with
- appropriate accommodations or support services, especially during the school years.
- Moderate: Marked difficulties learning skills in one or more academic domains, so that
- the individual is unlikely to become proficient without some intervals of intensive and
- specialized teaching during the school years. Some accommodations or supportive
- services at least part of the day at school, in the workplace, or at home may be needed
- to complete activities accurately and efficiently.
- Severe: Severe difficulties learning skills, affecting several academic domains, so that
- the individual is unlikely to learn those skills without ongoing intensive individualized
- and specialized teaching for most of the school years. Even with an array of appropriate
- accommodations or services at home, at school, or in the workplace, the individual
- may not be able to complete all activities efficiently.

# Description

# Persistence

- The learning
- difficulties are persistent, not transitory. In children and adolescents, persistence is defined as
- restricted progress in learning (i.e., no evidence that the individual is catching up with classmates)
- for at least 6 months despite the provision of extra help at home or school. For example,
- difficulties learning to read single words that do not fully or rapidly remit with the provision of
- instruction in phonological skills or word identification strategies may indicate a specific
- learning disorder. Evidence of persistent learning difficulties may be derived from cumulative
- school reports, portfolios of the child's evaluated work, curriculum-based measures, or clinical
- interview. In adults, persistent difficulty refers to ongoing difficulties in literacy or numeracy
- skills that manifest during childhood or adolescence, as indicated by cumulative evidence

# Low achievement

- A second key feature is that the individual's performance of the affected academic skills is
- well below average for age (Criterion B). One robust clinical indicator of difficulties learning
- academic skills is low academic achievement for age or average achievement that is sustainable
- only by extraordinarily high levels of effort or support. In children, the low academic skills
- cause significant interference in school performance (as indicated by school reports and
- teacher's grades or ratings). Another clinical indicator, particularly in adults, is avoidance of
- activities that require the academic skills. Also in adulthood, low academic skills interfere with
- occupational performance or everyday activities requiring those skills (as indicated by self-report
- or report by others). However, this criterion also requires psychometric evidence from an
- individually administered, psychometrically sound and culturally appropriate test of academic
- achievement that is norm-referenced or criterion-referenced. Academic skills are distributed
- along a continuum, so there is no natural cutpoint that can be used to differentiate
- individuals with and without specific learning disorder. Thus, any threshold used to specify
- what constitutes significantly low academic achievement (e.g., academic skills weU below age
- expectation) is to a large extent arbitrary. Low achievement scores on one or more standardized
- tests or subtests within an academic domain (i.e., at least 1.5 standard deviations [SD] below
- the population mean for age, which translates to a standard score of 78 or less, which is
- below the 7th percentile) are needed for the greatest diagnostic certainty

# Exclusion factors: intelligence

- Another key diagnostic feature is that the learning difficulties are considered "specific,"
- for four reasons. First, they are not attributable to intellectual disabilities (intellectual
- disability [intellectual developmental disorder]); global developmental delay;
- hearing or vision disorders, or neurological or motor disorders) (Criterion D). Specific
- learning disorder affects learning in individuals who otherwise demonstrate normal levels
- of intellectual functioning (generally estimated by an IQ score of greater than about 70
- [ • }5 points allowing for measurement error]). The phrase "unexpected academic underachievement"
- is often cited as the defining characteristic of specific learning disorder in
- that the specific learning disabilities are not part of a more general learning difficulty as
- manifested in intellectual disability or global developmental delay. Specific learning disorder
- may also occur in individuals identified as intellectually "gifted." These individuals
- may be able to sustain apparentiy adequate academic functioning by using compensatory
- strategies, extraordinarily high effort,

# Complex diagnosis

- No single data source is sufficient for a diagnosis of specific learning
- disorder. Rather, specific learning disorder is a clinical diagnosis based on a synthesis of
- the individual's medical, developmental, educational, and family history; the history of the
- learning difficulty, including its previous and current manifestation; the impact of the difficulty
- on academic, occupational, or social functioning; previous or current school reports;
- portfolios of work requiring academic skills; curriculum-based assessments; and previous or
- current scores from individual standardized tests of academic achievement. If an intellectual,
- sensory, neurological, or motor disorder is suspected, then the clinical assessment for specific
- learning disorder should also include methods appropriate for these disorders. Thus, comprehensive
- assessment will involve professionals with expertise in specific learning disorder and
- psychological/cognitive assessment. Since specific learning disorder typically persists into
- adulthood, reassessment is rarely necessary, unless indicated by marked changes in the learning
- difficulties (amelioration or worsening) or requested for specific purposes.

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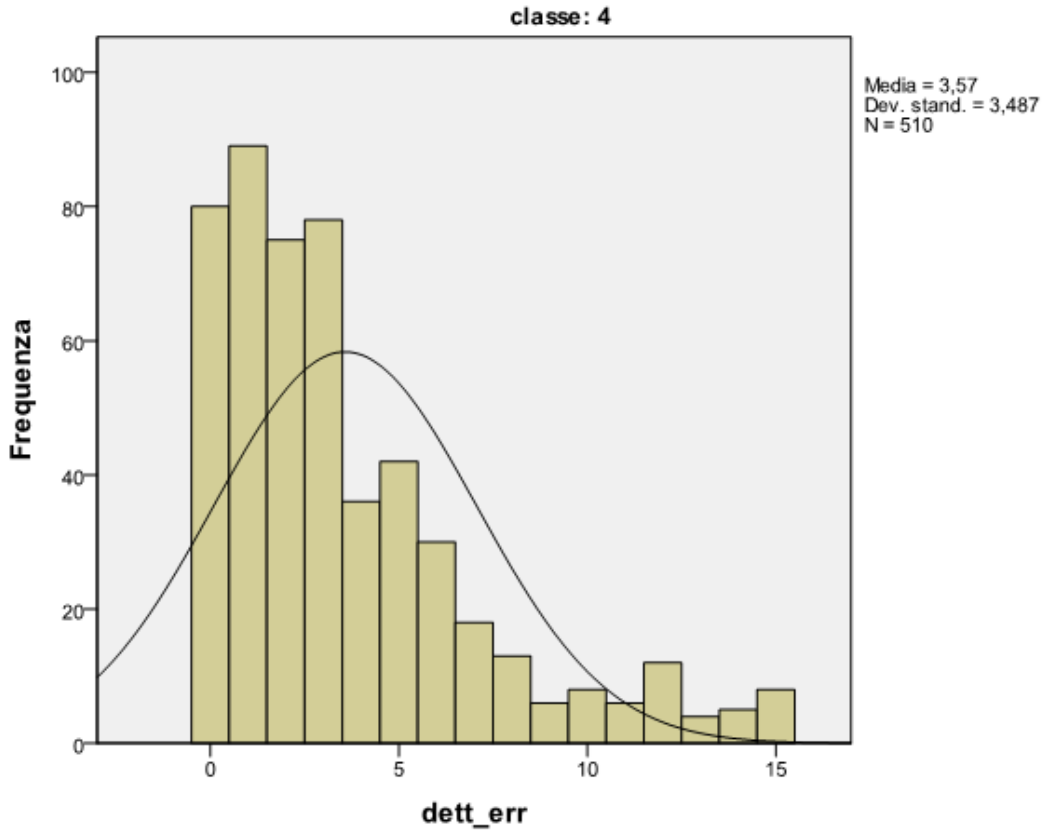


# Rationale for including clinical symptoms of LD as one criterion

- Clinical utility
  - DSM-IV-TR criteria for each of the 3 types of LD were based solely on psychometric criterion; implied the need for psychological assessment *prior* to recognition or identification of potential LD
  - Objective is to allow primary-care physicians or other non-LD-specialist clinicians to probe for & recognize learning problems – and to refer for formal psychological assessment to help rule in or rule out diagnosis of LD

# Rationale for psychometric criterion: ***Antecedent Validators***

- *Familial aggregation:*
  - Large-scale twin study, using multiple criteria for the definition of LD *(clinical history, low academic achievement, absence of intellectual, sensory or neurological disorders*) revealed strong genetic & environmental etiologies of co-existing RD & MLD, defined on the basis of a broader set of diagnostic criteria & not solely on IQ-achievement discrepancy (Light & DeFries, 1995).

- *SES, Gender, or cultural factors:*
  - *L*ongitudinal New Zealand birth cohort found evidence of a gender bias using an IQ-achievement discrepancy regression-based definition: it over-identified boys and under-identified girls (Share & Silva, 2003);
  - US longitudinal study found that reliance on an LD definition based solely on low academic achievement (<15$^{th}$ percentile) over-identified African-American students (Compton et al, 2012)

# Rationale for psychometric criterion: ***Concurrent Validators***

- *Cognitive factors (psychological processes):*
  - Most *(but not all -Fuchs et al, 2000)* meta-analyses & other studies of the cognitive processes associated with LD fail to find robust evidence of differences between LD groups with & without an IQ-achievement discrepancy (Hoskyn, 2000; Maehler 2011; Schuchardt et al., 2011; Stuebing 2002)
  - US population-based studies of DSM-IV-TR types of LD indicate that cumulative incident rates of each of these disorders varied according to which definition was used
    - IQ-achievement discrepancy, regression-based IQ-achievement discrepancy, low achievement (Barbaresi et al, 2005; Katusic et al, 2001; Katusic et al, 2009)
  - Taxometric investigation of different manifestations of RD, involving a large sample of children with severe RD found that the latent structure of RD varied according to use of IQ-discrepancy or Low-Achievement discrepancy definition (O'Brien et al., 2012)

# Rationale for exclusion of psychological processes in diagnostic criteria

- *Clinical utility*:
  - If included, diagnosis must await full & costly psychological/neuropsychological assessment; may result in inequitable access to such assessment
- *Scientific*:
  - Evidence that psychological processes associated with RD –the most common & well-documented LD – are probabilistic, varied, & reliance on phonemic awareness for diagnosis would miss many individuals (Pennington et al 2012)
  - Psychological processes associated with math or written expression remain unclear – especially cross-culturally
  - BUT, measures of neurocognitive processing *(e.g., phonological memory, visual processes, specific components of intellectual functioning)* found to be stronger predictors than phonological processing measures of both good & poor response to reading intervention- suggesting their utility for intervention (Frijters et al, 2011)

# Associated Features Supporting Diagnosis

- 1 Specific learning disorder is frequently but not invariably preceded, in preschool years, by
- delays in attention, language, or motor skills that may persist and co-occur with specific
- learning disorder

- 2 An uneven profile of abilities is common, such as above-average abilities in drawing, design, and other visuospatial abilities,

- 3 Individuals with specific
- learning disorder typically (but not invariably) exhibit poor performance on psychological
- tests of cognitive processing. However, it remains unclear whether these cognitive
- abnormalities are the cause, correlate, or consequence of the learning difficulties. Also, although
- cognitive deficits associated with difficulties learning to read words are well documented,
- those associated with other manifestations of specific learning disorder (e.g.,
- reading comprehension, arithmetic computation, written expression) are underspecified
- or unknown. Moreover, individuals with similar behavioral symptoms or test scores are
- found to have a variety of cognitive deficits, and many of these processing deficits are also
- found in other neurodevelopmental disorders (e.g., attention-deficit/hyperactivity disorder
- [ADHD], autistic spectrum disorder, communication disorders, developmental coordination
- disorder). Thus, assessment of cognitive processing deficits is not required for
- diagnostic assessment

- 4 Specific learning disorder is associated with increased risk for suicidal ideation and suicide attempts in children, adolescents, and adults

- 5 There are no known biological markers of specific learning disorder. As a group, individuals with the disorder show circumscribed alterations in cognitive processing and brain structure and function. Genetic differences are also evident at the group level. But cognitive testing, neuroimaging, or genetic testing are not useful for diagnosis at this time.

# Developmental course: preschool

- Changes in manifestation of symptoms occur with age, so that an individual may have
- a persistent or shifting array of learning difficulties across the lifespan.
- Examples of symptoms that may be observed among preschool-age children include a lack
- of interest in playing games with language sounds (e.g., repetition, rhyming), and they may
- have trouble learning nursery rhymes. Preschool children with specific learning disorder may
- frequently use baby talk, mispronounce words, and have trouble remembering names of letters,
- numbers, or days of the week. They may fail to recognize letters in their own names and
- have trouble learning to count. Kindergarten-age children with specific learning disorder may
- be unable to recognize and write letters, may be unable to write their own names, or may use
- invented spelling. They may have trouble breaking down spoken words into syllables (e.g.,
- "cowboy" into "cow" and "boy") and trouble recognizing words that rhyme (e.g., cat, bat, hat).
- Kindergarten-age children also may have trouble cormecting letters with their sounds (e.g., letter
- b makes the sound /b/) and may be unable to recognize phonemes (e.g., do not know
- which in a set of words [e.g., dog, man, car] starts with the same sound as "cat").
- Specific learning disorder in elementary school-age children typically manifests as
- marked difficulty learning letter-sound correspondence (particularly in English-speaking
- children), fluent word decoding, spelling, or math facts; reading aloud is slow, inaccurate,
- and effortful, and some children struggle to understand the magnitude that a spoken or
- written number represents.

# Primary school: grades 1-3

- Children in primary grades (grades 1-3) may continue to have
- problems recognizing and manipulating phonemes, be unable to read common one-syllable words (such as mat or top), and be unable recognize common irregularly spelled words (e.g., said, two). They may commit reading errors that indicate problems in connecting sounds and letters (e.g., "big" for "got") and have difficulty sequencing numbers and letters. Children in grades 1-3 also may have difficulty remembering number facts or
- arithmetic procedures for adding, subtracting, and so forth, and may complain that reading or arithmetic is hard and avoid doing it

# Grades 4-6

- Children with specific learning disorder in the middle grades (grades 4-6) may mispronounce or skip parts of long, multisyllable words
- (e.g., say "conible" for "convertible," "aminal" for "animal") and confuse words that
- sound alike (e.g., "tornado" for "volcano"). They may have trouble remembering dates,
- names, and telephone numbers and may have trouble completing homework or tests on
- time. Children in the middle grades also may have poor comprehension with or without
- slow, effortful, and inaccurate reading, and they may have trouble reading small function
- words (e.g., that, the, an, in). They may have very poor spelling and poor written work.
- They may get the first part of a word correctly, then guess wildly (e.g., read "clover" as
- "clock"), and may express fear of reading aloud or refuse to read aloud.

# Adolescence

- By contrast, adolescents may have mastered word decoding, but reading remains slow
- and effortful, and they are likely to show marked problems in reading comprehension and
- written expression (including poor spelling) and poor mastery of math facts or mathematical
- problem solving. During adolescence and into adulthood, individuals with specific
- learning disorder may continue to make numerous spelling mistakes and read single
- words and connected text slowly and with much effort, with trouble pronouncing multisyllable
- words. They may frequently need to reread material to understand or get the main
- point and have trouble making inferences from written text. Adolescents and adults may
- avoid activities that demand reading or arithmetic (reading for pleasure, reading instructions).

# Adulthood

- Adults with specific learning disorder have ongoing spelling problems, slow and
- effortful reading, or problems making important inferences from numerical information
- in work-related written documents. They may avoid both leisure and work-related activities
- that demand reading or writing or use alternative approaches to access print (e.g.,
- text-to-speech/speech-to-text software, audiobooks, audiovisual media).

# Specific weaknesses

- An alternative clinical expression is that of circumscribed learning difficulties that persist across the lifespan, such as an inability to master the basic sense of number (e.g., to know which of a pair of numbers or dots represents the larger magnitude), or lack of proficiency
- in word identification or spelling.

# Risk and Prognostic Factors

- **Environmental**. Prematurity or very low birth weight increases the risk for specific
- learning disorder, as does prenatal exposure to nicotine.
- **Genetic** and physiological. Specific learning disorder appears to aggregate in families,
- particularly when affecting reading, mathematics, and spelling. The relative risk of specific
- learning disorder in reading or mathematics is substantially higher (e.g., 4-8 times
- and 5-10 times higher, respectively) in first-degree relatives of individuals with these
- learning difficulties compared with those without them
- **Course** modifiers. Marked problems with inattentive behavior in preschool years is predictive
- of later difficulties in reading and mathematics (but not necessarily specific learning
- disorder) and nonresponse to effective academic interventions

# Culture-Related Diagnostic issues

- In the English language, the observable hallmark clinical symptom of difficulties
- learning to read is inaccurate and slow reading of single words; in other alphabetic
- languages that have more direct mapping between sounds and letters (e.g., Spanish, German) and in non-alphabetic languages (e.g., Chinese, Japanese), the hallmark feature is slow but accurate reading.

# Epidemiological data: questionable

- Prevalence
- According to DSM-5 the prevalence of specific learning disorder across the academic domains of reading, writing,
- and mathematics is 5%-15% among school-age children across different languages and cultures. Prevalence in adults is unknown but appears to be approximately 4%.

- Gender-Related Diagnostic issues
- Specific learning disorder is more common in males than in females (ratios range from about 2:1 to 3:1) and cannot be attributed to factors such as ascertainment bias, definitional
- or measurement variation, language, race, or socioeconomic status.

# Estimated prevalences in Italy

TAB. 1. *Incidenza percentuale dei tipi fondamentali di difficoltà di apprendimento scolastico*

| Tipo di difficoltà | Maschi | Femmine |
|---|---|---|
| Basso rendimento scolastico | 13 | 7 |
| Disturbi specifici dell'apprendimento | 4,5 | 3,5 |
| Disturbi del linguaggio | 1,5 | 1 |
| Disturbi di attenzione | 5 | 1,25 |
| Ritardo mentale | 1 | 1 |
| Disturbi di personalità | 1 | 1 |
| Disabilità plurime | 0,15 | 0,15 |
| Sordità e ipoacusia | 0,1 | 0,1 |

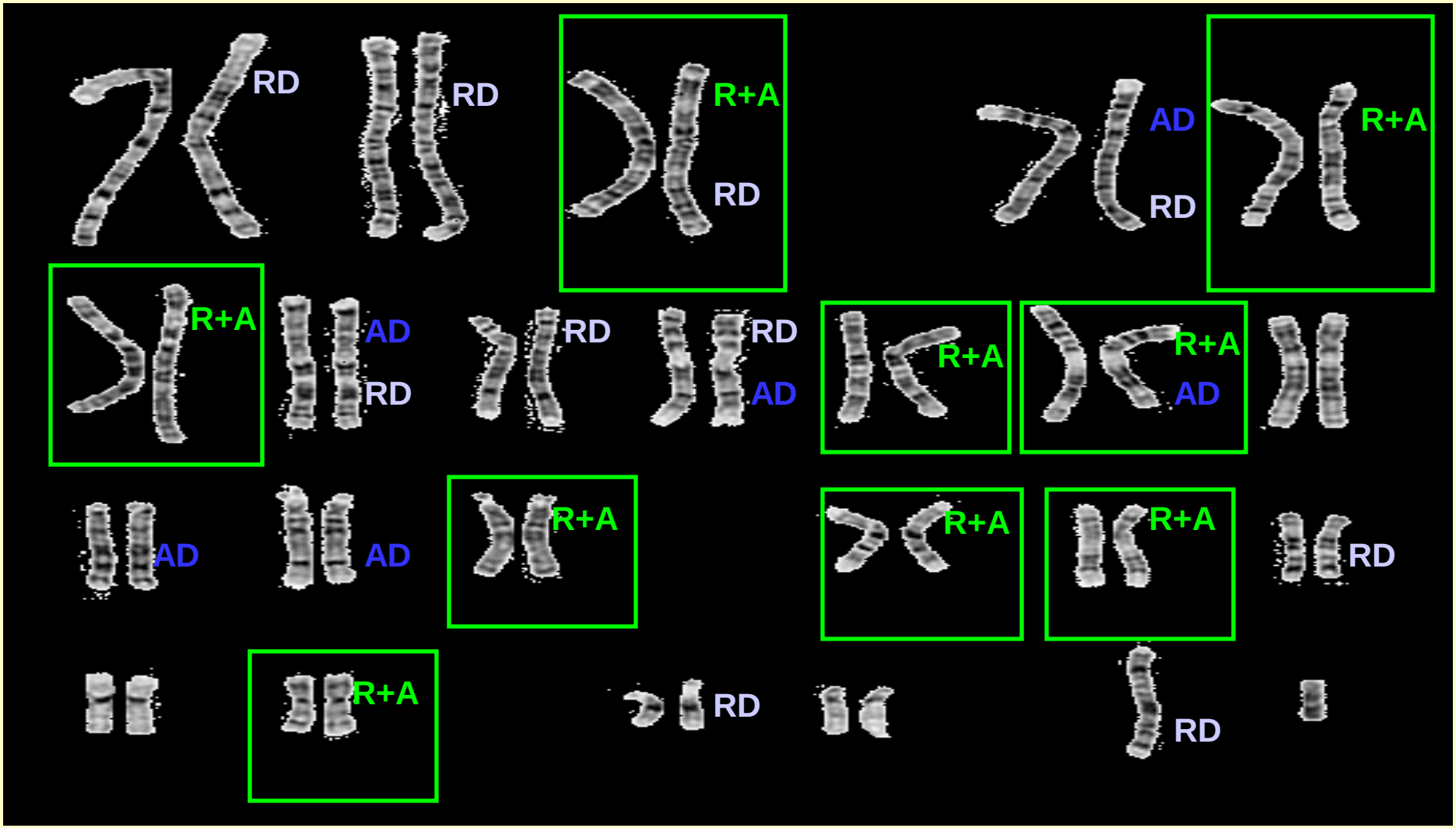
*Fonte*: Cornoldi, 1999

# Functional Consequences of Specific Learning Disorder

- Specific learning disorder can have negative functional consequences across the lifespan,
- including lower academic attainment, higher rates of high school dropout, lower rates of
- postsecondary education, high levels of psychological distress and poorer overall mental
- health, higher rates of unemployment and under-employment, and lower incomes. School
- dropout and co-occurring depressive symptoms increase the risk for poor mental health
- outcomes, including suicidality, whereas high levels of social or emotional support predict
- better mental health outcomes.

- Comorbidity
- Specific learning disorder commonly co-occurs with neurodevelopmental (e.g., ADHD,
- communication disorders, developmental coordination disorder, autistic spectrum disorder)
- or other mental disorders (e.g., anxiety disorders, depressive and bipolar disorders).
- These comorbidities do not necessarily exclude the diagnosis specific learning disorder

# Possible Locations of Genes That Influence RD, ADHD, or both RD and ADHD



**Measures**

| Latent Variable | Measures Used to Predict Latent Variable |
|---|---|
| Reading Ability | *Time limited word recognition task, PIAT Reading Recognition, & PIAT Spelling* |
| Inattention Symptoms | *Mother, Father, Teacher, & Examiner Ratings* |
| Hyperactive/Impulsive Symptoms | *Mother, Father, Teacher, & Examiner Ratings* |
| PA | *Phoneme Deletion (% correct, blocks 1 & 2), Pig Latin test, & the Lindamood Auditory Conceptualization task* |
| VR | *Information, Similarities, Vocabulary, & Comprehension from the WISC-R* |
| WM | *Nonword Repetition, Digit Span (Forward & Backward), Sentence Span & Counting Span* |
| Inhibition | *Gordon Diagnostic System commission errors (Vigilance & Distractibility), & Stop Signal Reaction Time from the Stop Task* |
| PS | *WISC-R Coding, WISC-III Symbol Search, Colorado Perceptual Speed Task,Identical Pictures, Trailmaking Test, Rapid Automatized Naming Task (Colors, Numbers, Letters, & Pictures) & Stroop Task (Word Naming & Color Naming)* |

*Note*. For ADHD, mean severity ratings from each rater were used as the indicators. This strategy allows for more variance than the more typical strategy of defining ADHD using symptom counts.

*Note*. Errors from the same instrument (e.g., WISC Coding and Symbol Search) were allowed to correlate in both measurement models.

## Results

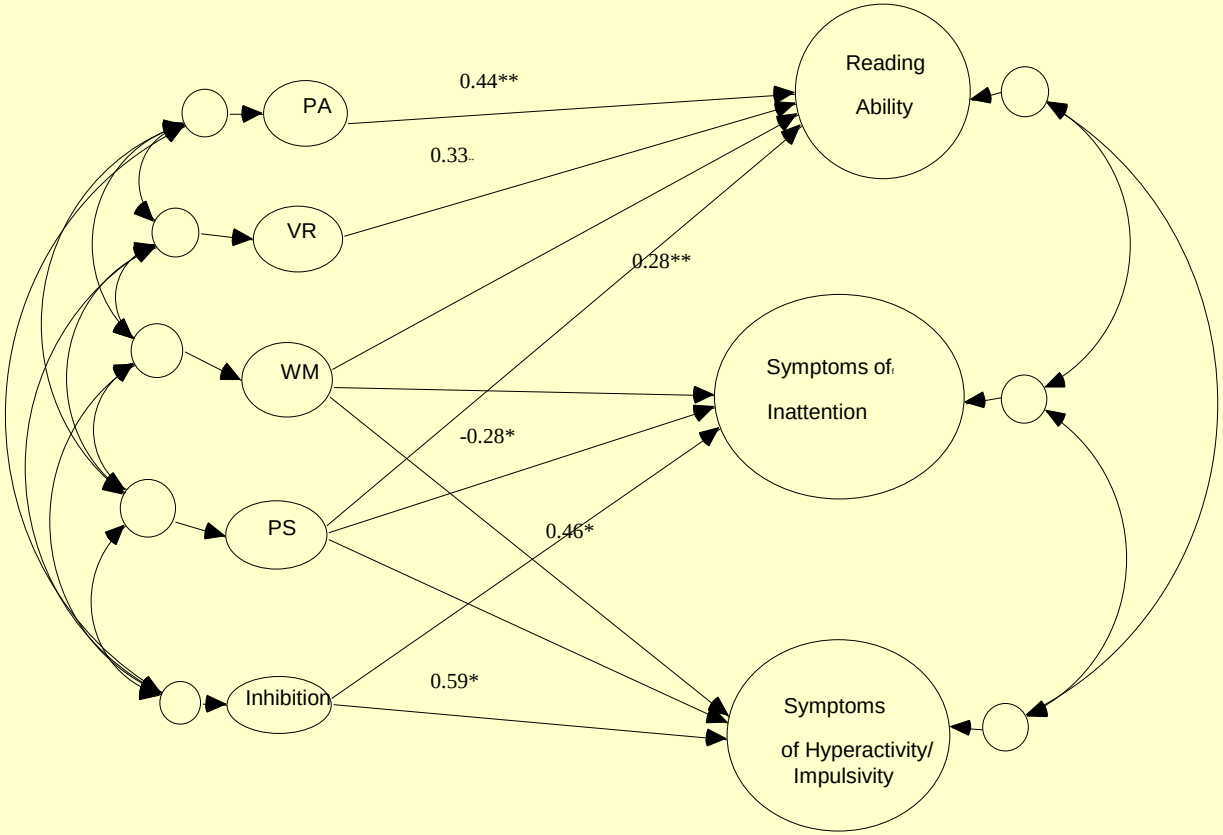
### Measurement Model

The best fitting measurement model was one which created separate latent variables for the continuous symptoms of inattention and symptoms of hyperactivity/impulsivity ($\chi 2$ /df= 2.303, CFI= 0.986, RMSEA=0.045).

The measurement model for the latent variables of the the cognitive constructs was also a good fitting model ($\chi 2$ /df= 3.187, CFI= 0.915, RMSEA=0.059).

### Full SEM Model

The full SEM model was also a good fit ($\chi 2$ /df= 2.63, CFI= 0.918, RMSEA=0.05



# Critical Issues for the Field

- Causality
  - what causes the problems we see?
- Co-morbidity
  - How can we understand the co-occurrence of disorders

# Causes

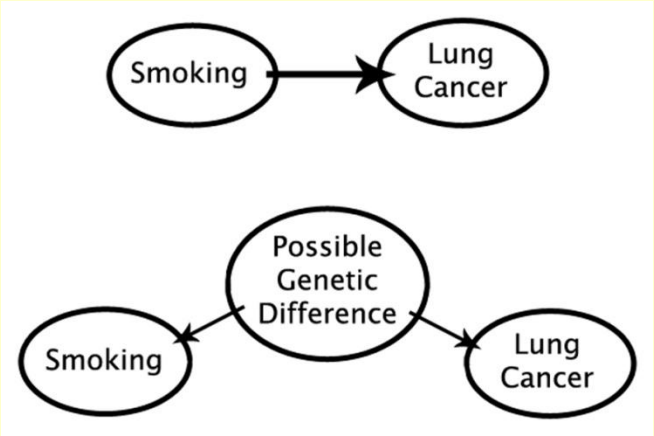
- The term ‘cause’ refers to a relationship between two events or conditions
- Causes only exist within a well-specified theory
- Causes operate probabilistically (causal risk factors)
- Causes operate forwards in time (the logic of causal order)
- The starting point for thinking that we might have identified a cause is with correlations

# Causes

- In studies of developmental disorders we can never practically or ethically manipulate the ultimate causes (genes and environments) of a disorder
- But, identifying the causes at the Cognitive Level of explanation is crucial for planning effective treatments/interventions
- If interventions are successful we may, using mediation analyses, get close to identifying the ‘proximal’ causes of a disorder

# Path Diagrams as Representations of Causal Theories

- In a path diagram *Causes* and *Consequences* are linked by one headed arrows

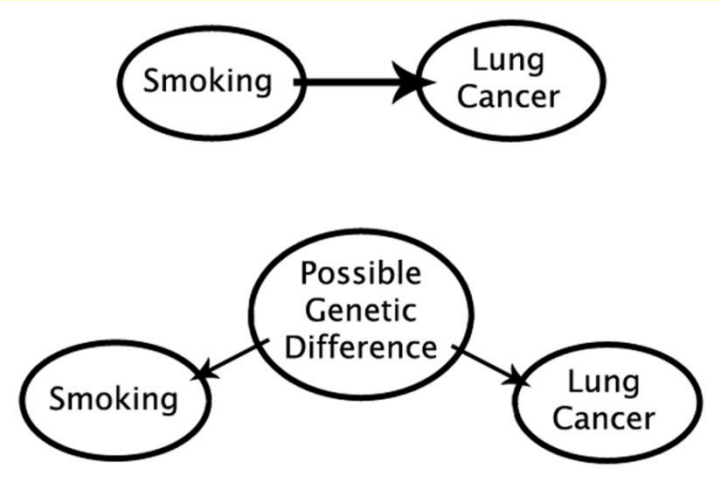



- Here are two possible causal theories about the correlation between smoking and the development of lung cancer

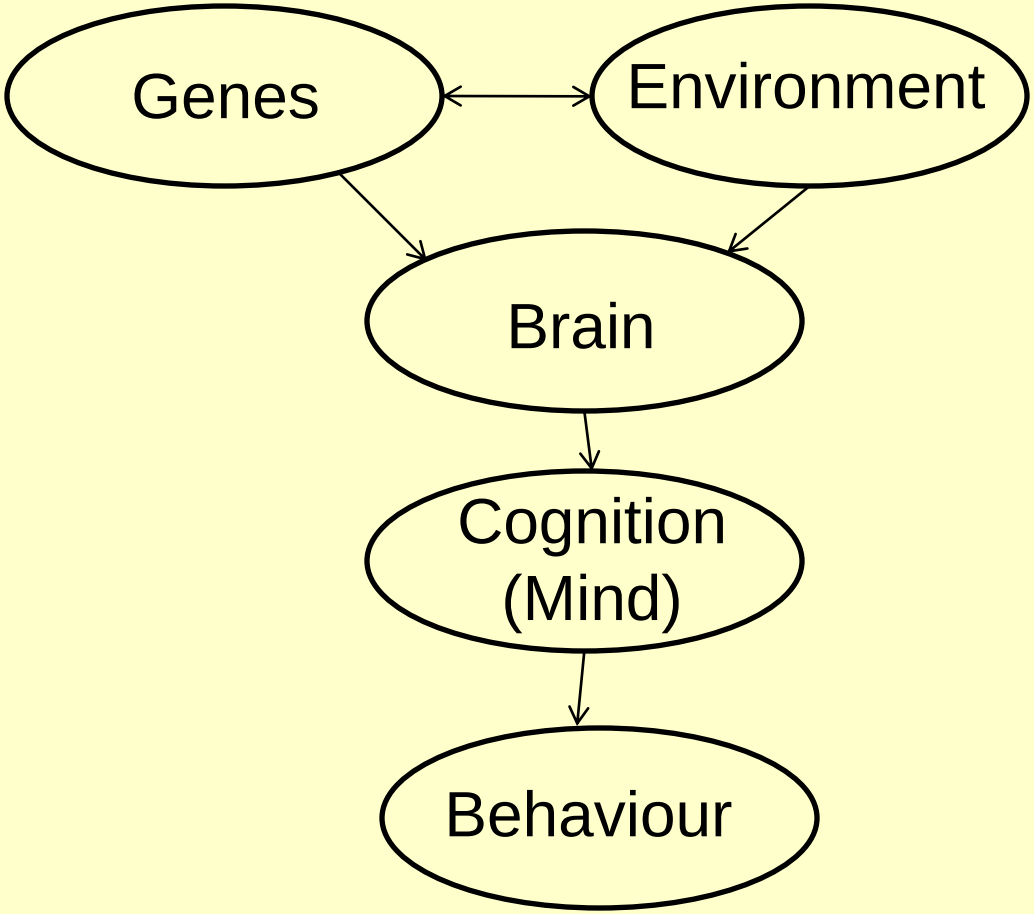
1. Smoking is a Cause of Lung Cancer
2. Smoking and Lung Cancer have no causal relationship – they both arise from a tertium quid (a common factor – a shared genetic disposition?)

# Path Diagrams as Representations of Causal Theories

- According to Theory 1 preventing people from smoking will reduce rates of lung cancer
- According to Theory 2 preventing people from smoking will have no effect on rates of lung cancer

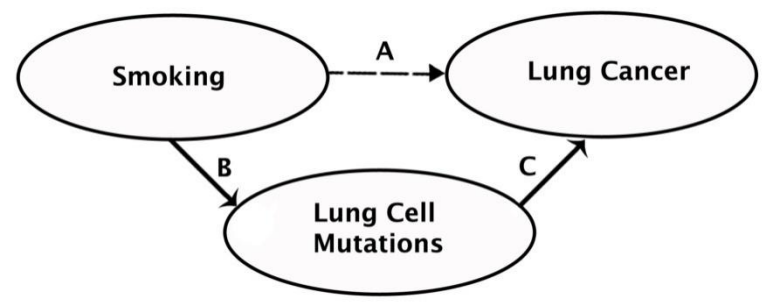


# A General Path Diagram for Developmental Disorders



# Direct versus mediated relationships

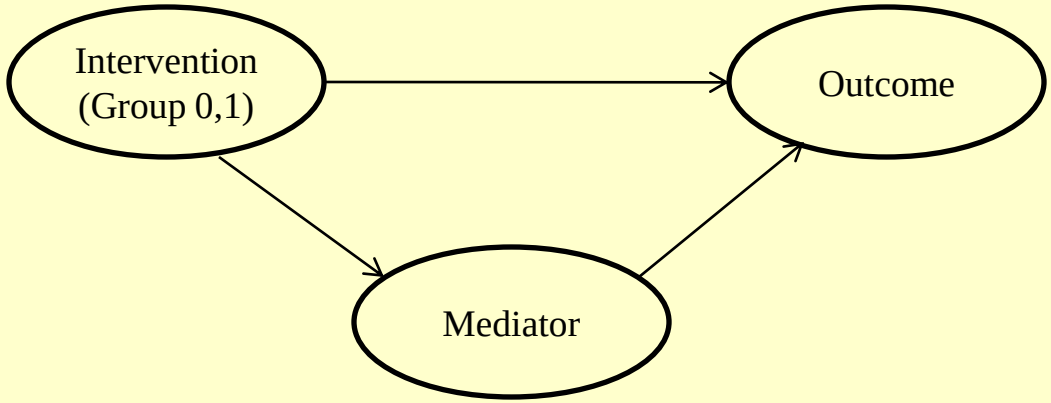
- Let's go back to the example of Lung Cancer, and elaborate it.




- Baron & Kenny outlined the steps needed to test mediation:
  - 1. Establish (A) - cause predicts outcome (sig univariate regression)
  - 2. Establish (B) - cause predicts mediator (sig univariate regression)
  - 3. Establish (C)-mediator predicts outcome (sig univariate regression)
  - 4. If 1, 2, and 3 are true: In a simultaneous regression predicting outcome from mediator and cause (paths A &C) path C should be significant and path A should be zero (complete mediation) or at least reduced in size (partial mediation)

# Mediators in Intervention Studies

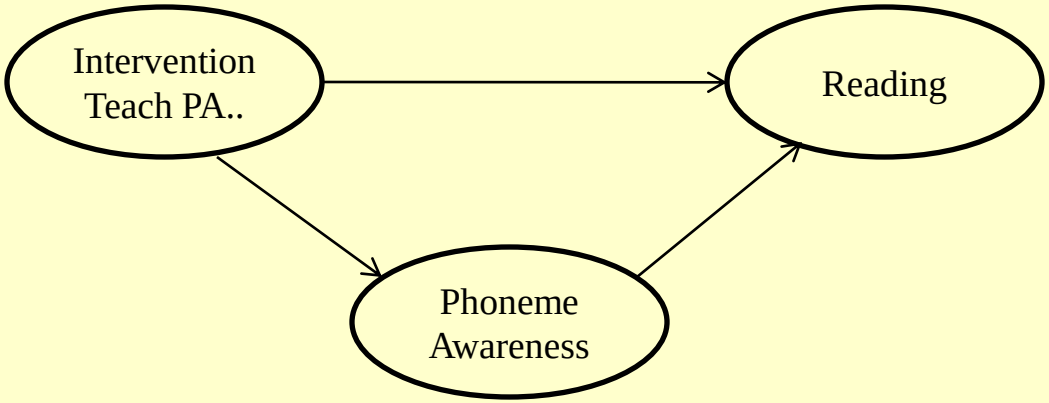
- Apply this idea to an intervention design



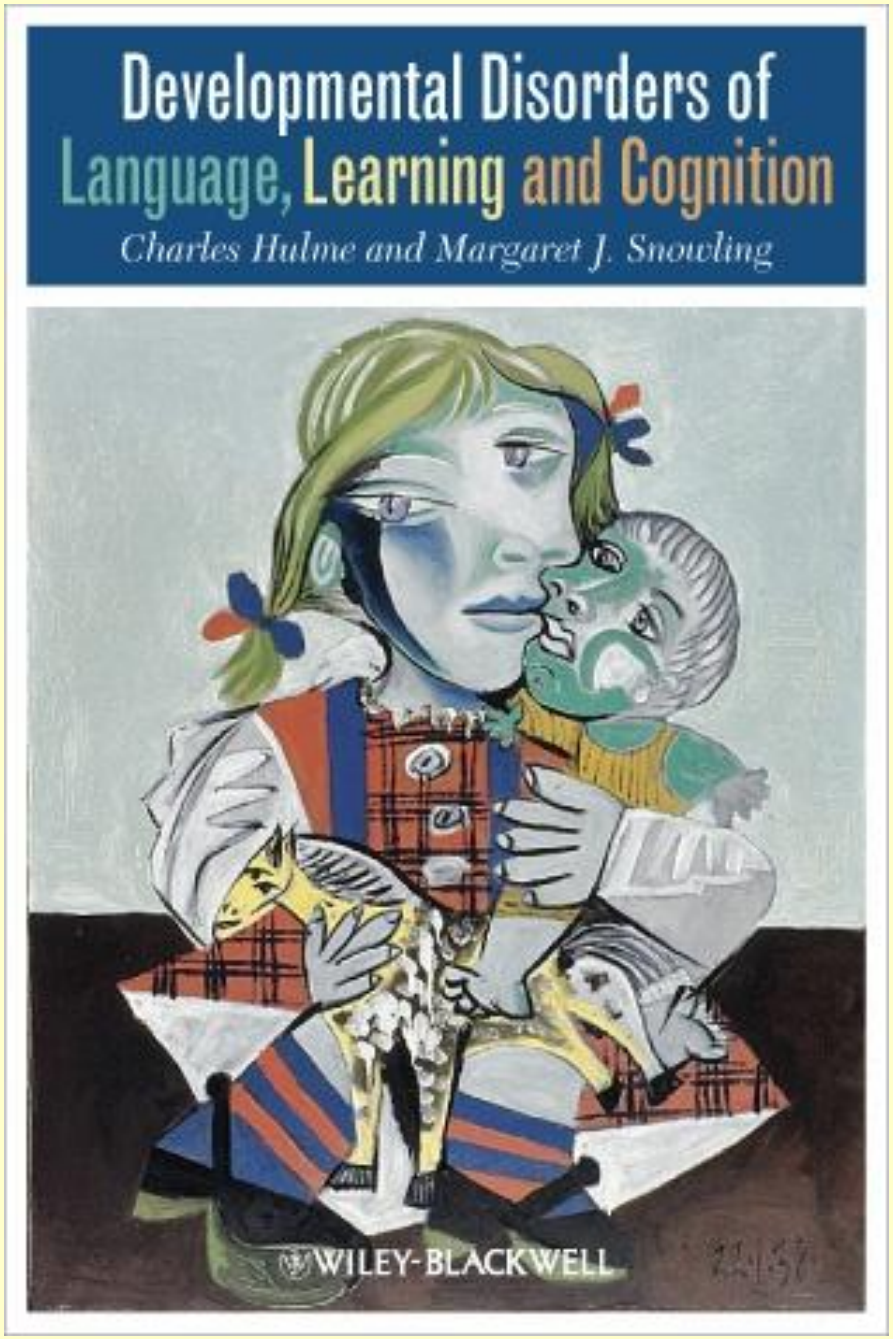

- Here group is coded as a dummy variable (control vs. Intervention 0,1)
- We can assess whether the effects of the intervention on outcome are mediated or direct

# Mediators in Intervention Studies

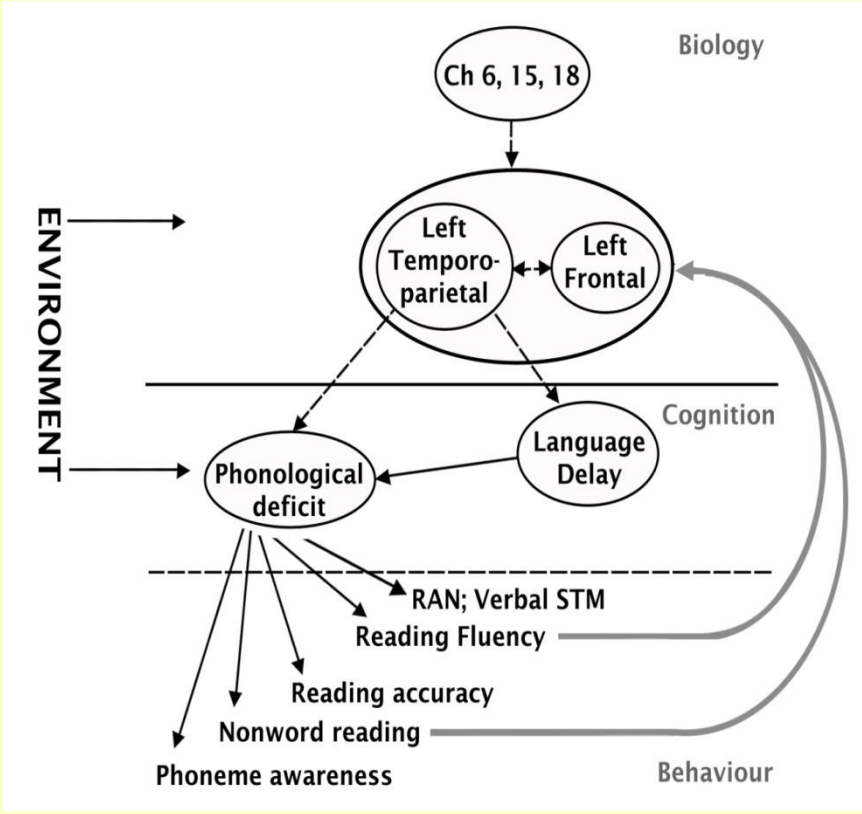
- Apply this idea to an intervention design for Reading




- If variations in Phoneme Awareness are causally related to reading teaching PA should improve reading – *to the extent to which PA increases*




# Causal Model of Dyslexia

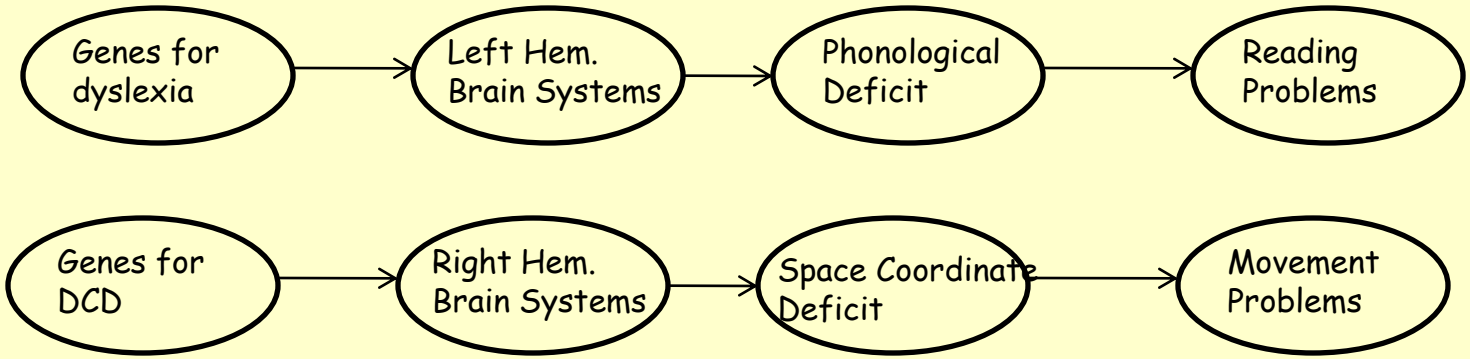


# Testing Causal Theories using Mediators in Intervention Studies

- I have outlined a causal theory that sees reading development (decoding) as depending upon 2 causal factors: phonemic skills and letter knowledge
- Decoding difficulties (dyslexia) can be expected to depend upon deficits in these 2 underlying skills
- This causal theory implies that training phonemic skills and letter knowledge should improve children's reading
- It also implies that reading should improve *to the extent that* the underlying skills improve (a mediated relationship)

# Are reading disorders (and other disorders) specific?

- Some outstanding issues:
- So far we have spoken as if disorders are specific?



# Disorders are not (totally) specific: Comorbidity

- Different disorders commonly co-occur in the same child – Comorbidity (true comorbidity)
- Arguably - comorbidity has been a source of confusion in relation to the diagnosis and treatment of developmental disorders
- Because comorbidity is so common we must think in terms of “shared risk factors” for different disorders
- Genes do not operate in totally specific ways (and nor do environmental influences)

# Co-morbidity and Confusion?

- Arguably comorbidity has been a source of much confusion in attempts to identify the causes of disorders and to formulate treatments
- For example, motor disorders are commonly comorbid with dyslexia
- This does not mean that testing balance will be useful as means of identifying dyslexia!
- Or, worse still, that teaching children to balance will help them learn to read!!