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SYSTEMATIC REVIEW

When Theory Trumps Science: a Critique of the PSW Model for SLD Identification

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Abstract There has been vigorous debate within the state of California and elsewhere as to what constitutes appropriate procedures for determining whether an individual qualifies for special education and related services under the category of specific learning disability (SLD). Within the professional literature, there is growing support for educational agencies to adopt an approach to SLD identification that emphasizes the importance of an individual's pattern of cognitive and achievement strengths and weaknesses (PSW). In 2014, the California Association of School Psychologists released a position paper endorsing this approach. As a vehicle for examining the PSW model, we respond critically to three fundamental positions taken in the position paper: (a) diagnostic validity for the model has been established; (b) cognitive profile analysis is valid and reliable; and (c) PSW data have adequate treatment utility. We conclude that at the present time there is insufficient support within the empirical literature to support adoption of the PSW method for SLD identification. Implications for professional practice are discussed.

Keywords Specific learning disability · PSW · Diagnostic validity

There has been vigorous debate in the field of school psychology as to what constitutes appropriate procedures for determining whether an individual qualifies for special education and related services under the category of specific learning disability (SLD). Prior to IDEA 2004, federal regulations emphasized the primacy of the discrepancy model, wherein SLD was operationalized as a significant discrepancy between an individual's achievement and their cognitive ability (Aaron 1997). In contrast to previous legislation, IDEA 2004 permitted local educational agencies the option of selecting between the discrepancy method and alternatives such as response-to-intervention (RTI).

Over the last decade, RTI has been widely embraced within the technical literature and adopted as an SLD classification model by many educational agencies across the country (Maki et al. 2015), resulting in renewed concern regarding the validity of identification approaches that deemphasize the role of cognitive testing (Hale et al. 2008; McDermott et al. 2006; Reynolds and Shaywitz 2009). Some scholars (e.g., Dixon et al. 2010; Flanagan et al. 2006) have argued that RTI, with its emphasis on curriculum-based probes and other forms of direct academic assessment, fail to provide users with information about the fundamental nature of SLD as defined within the federal regulations (e.g., the neurobiological/processing origin of the disorder). It is important to note that the federal definition of SLD does not explicitly require that cognitive processing deficits must be measured or assessed or that standardized tests are required, although it is required in a minority of states such as California (Lichtenstein 2014).

In light of the concerns raised by researchers, alternatives to RTI have been proposed that emphasize the importance of cognitive testing with respect to SLD identification and treatment. In contrast to the discrepancy model, which placed primacy on the interpretation of an individual's full scale IQ score, these emerging models focus on interpreting a student's pattern of factor or index level scores across a battery of tests for the purpose of determining cognitive strengths and weaknesses, an approach to assessment and interpretation of

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cognitive measures that is referred to as *pattern of strengths and weaknesses* or PSW.

A Review of Contemporary PSW Models

To date, several models have been proposed that attempt to operationalize PSW, including (a) the concordance/discordance model (C/DM; Hale and Fiorello 2004), (b) the Cattell-Horn-Carroll operational model (CHC; Flanagan et al. 2011), and (c) the discrepancy/consistency model (D/CM; Naglieri 2011). It is noteworthy that, although the models described below differ with respect to their theoretical orientations and the statistical formulae used to identify patterns of strengths and weakness, all three PSW models share at least three core assumptions as related to the diagnosis of SLD: (a) evidence of cognitive weaknesses must be present, (b) an academic weakness must also be established, and (c) there must be evidence of "spared" (i.e., not indicative of a weakness) cognitive-achievement abilities (Flanagan and Alfonso 2015).

Concordant/Discordant Model (C/DM)

The C/DM approach suggests that SLD is demonstrated by an exclusive pattern of concordance (consistent performance with a reference variable) and discordance (inconsistent performance with a reference variable) within a person's cognitive-achievement ability profile. Specifically, a clinician using this approach must observe a statistically significant relationship between cognitive processing and achievement weaknesses. Evidence must also be provided that establishes a statistically significant discrepancy between the identified area(s) of weakness and relative cognitive-achievement strengths (Hale and Fiorello 2004; Hale et al. 2011). This approach capitalizes on the correlational relationships between cognitive-achievement variables in that when a cognitive ability is related to an area of achievement that is considered to be an area of weakness there is a strong possibility that the related cognitive ability will also be low. Conversely, cognitive-achievement abilities that do not have strong relationships with an observed area(s) of weakness should be spared. Potential concordances and discordances are determined to be statistically significant if they exceed critical values obtained using the standard error of the difference (SED) formula (see Hale et al. 2011 for a demonstration).

Cattell-Horn-Carroll Operational Model (CHC)

The CHC approach uses the Cattell-Horn-Carroll model of cognitive abilities (CHC; Schneider and McGrew 2012) as a theoretical foundation for creating an operational definition for determining SLD eligibility. Clinicians administer measures that correspond to the seven Stratum II "broad" cognitive abilities in the CHC model and then compare the obtained scores to scores from a norm-referenced test of achievement. Similar to other PSW approaches, SLD is demarcated by a normative processing weakness (e.g., standard score ≤89), a normative academic weakness that is hypothesized to be causally related to the processing weakness, and a pattern of otherwise normal achievement and cognitive functioning in unrelated domains (Flanagan et al. 2006, 2010). The Woodcock-Johnson Tests of Cognitive Abilities -Fourth Edition (WJ-IV; Schrank et al. 2014) is the only contemporary cognitive measure to fully operationalize the latest iteration of the CHC model. Consequently, within this PSW framework, clinicians may can obtain complete CHC cognitive profiles by administering the measure in its entirety or by combining subtest scores from a combination of test instruments using a cross-battery approach (XBA; see Flanagan et al. 2013).

There is an alternative iteration of the CHC operational model cited in the literature (i.e., Flanagan and Alfonso 2015), referred to as the Dual/Discrepancy Consistency model (DDC). The DDC model incorporates additional non-CHC neurocognitive constructs from school neuropsychology assessment models (e.g., Miller 2013). Although there is significant overlap between the CHC and DDC models as related to the integration of assessment data, the DDC model requires users to more explicitly identify facilitating neurocognitive processes that are functionally related to spared achievement abilities as well as inhibiting neurocognitive processes that result in achievement deficits through the recently published Cross-Battery Assessment System Software System (X-BASS; Flanagan et al. 2015). Although a review of the X-BASS is beyond the scope of the present critique, it should be noted that the clinical and diagnostic utility of the program has yet to be established in the literature.

Discrepancy/Consistency Model (D/CM)

The D/CM method, first described by Naglieri (1999), is a systematic procedure for examining profile variability on cognitive and academic measures using ipsative analysis (Davis 1959). Ipsative analysis involves examining the deviation of cognitive scores from the mean of the profile of scores (e.g., subtests or composite scores) for an individual. The obtained deviation scores are then compared to pre-determined thresholds (as reported in most technical manuals) and those scores that are determined to be statistically significant are referred to as relative strengths or weaknesses depending on the direction of the difference from the mean. According to Naglieri (2011), dual criteria are applied to determine the degree to which a score is a cognitive weakness: (a) the score must represent a relative weakness and (b) the score must represent a normative

deficit (e.g., standard score ≤89). SLD determinations are made when an individual presents with a cognitive weakness that is related to an area of academic weakness along with a pattern of otherwise normal cognitive-academic performance. Naglieri (2011) stated that the D/CM approach can be used across instruments and/or theoretical orientations. However, the method is most often associated with the cognitive abilities measured by the Cognitive Assessment System-Second Edition (CAS-2; Naglieri et al. 2014).

California Association of School Psychologists (CASP) Position Paper on SLD Identification and PSW

Buoyed by the emergence of research investigating relationships between specific cognitive variables and achievement (e.g., McGrew and Wendling 2010), Hale et al. (2010) surveyed 58 experts with experience in SLD assessment regarding procedural best practices for diagnosing SLD and resolved that an "approach that identifies a pattern of psychological processing strengths and weaknesses, and achievement deficits consistent with this pattern of processing weaknesses, makes the most empirical and clinical sense" (p. 225). Since the publication of that white paper, discussions have arisen regarding the potential implementation and/or viability of the PSW model for SLD identification in the state of California. To wit, a California Association of School Psychologists (CASP) annual conference was devoted to the topic in 2012. Momentum for the adoption of the PSW model culminated in March 2014 with the release of a CASP position paper entitled *Specific Learning Disabilities and Patterns of Strengths and Weaknesses*. According to Christo and Jones (2014), the purpose of the position paper was to "provide its membership with *research-based* [emphasis added] knowledge regarding the identification of specific learning disabilities for students in California" (p. 1).

The position paper made several conclusions about the diagnostic validity and potential treatment utility of the PSW model. Despite the fact that the intent of the paper was to provide practitioners with a summation of *research-based* strategies for SLD identification, the authors did not provide any empirical support for the positions articulated within the document. As the professional literature is filled with evidence to question many of the claims made within the document (e.g., Dombrowski and Gischlar 2014; Fletcher et al. 2013; Miciak et al. 2014, 2015; McGill et al. 2015), we provide salient counterarguments to the three core assumptions made about the validity and clinical utility of PSW model for SLD identification and treatment. We believe that this review/critique is warranted given the recent revision of California state SLD regulations that permit the use of PSW procedures for SLD identification and the subsequent adoption of this model throughout the state by some educational agencies (e.g., Ventura County SELPA 2014).

Critical Assumption One: Diagnostic Validity for the Model Has Been Established

Christo and Jones (2014) stated that the PSW approach "provides the information essential to…make a determination that a student has a specific learning disability" (p. 2), implying that diagnostic validity for PSW as a reliable and valid model for SLD identification has been established. Whereas several studies have provided evidence indicating that PSW procedures may be useful for identifying various SLD subtypes (e.g., Carmichael et al. 2014; Fenwick et al. 2015; Feifer et al. 2014; Kubas et al. 2014), this information is not sufficient for establishing the diagnostic utility of these procedures (McFall and Treat 1999).

More explicit investigation of the diagnostic validity of PSW procedures have only recently begun to emerge in the technical literature. Steubing et al. (2012) investigated the diagnostic accuracy of several PSW models and reported high diagnostic specificity (i.e., true negative decisions) across all models. However, this high specificity resulted in an inflated type II error rate (i.e., false positive decisions). The authors concluded that the inflated error was likely the result of measurement artifacts produced by dichotomizing continuous data, a confound that is endemic to all SLD identification models. Accordingly, Fletcher et al. (2013) suggested that the imposition of a different classification model (e.g., PSW) may shift the focus on underlying causal variables but does not address these more fundamental psychometric concerns that apply to all diagnostic models which utilize these data.

More recently, Kranzler et al. (2016) examined the diagnostic validity of the XBA approach using data from the WJ-III within the diagnostic framework provided in an earlier version of the X-BASS software system with 300 participant's ages 6–19. Similar to Steubing et al. (2012), it was found that the sensitivity levels (i.e., ability to detect a true positive outcome) for the XBA method were far below minimum recommended levels in classification agreement analyses for "rule in" tests (Goffreda and DiPerna 2010). Particularly concerning was the fact that a positive XBA SLD outcome classified individuals identified with SLD at no better than chance levels. As a consequence, the authors concluded that "our PPV [positive predictive value] results suggest that clinicians will spend a great deal of time conducting assessments that have a very low probability of accurately identifying true SLD" (p.11).

As evident in our review of the PSW models that have been proposed in the literature, procedures for determining what constitutes a cognitive weakness differ significantly across the models. Accordingly, researchers have examined the

degree to which the models may converge in applied settings to identify the same individuals as having a SLD. A recent investigation by Miciak et al. (2015) found that the utilization of different assessment measures in the C/DM model resulted in poor classification agreement. Moreover, in a separate investigation, Miciak et al. (2014) found that diagnostic overlap in which an individual met SLD criteria according to different PSW models fluctuated between 13.6 and 62.1 % across different iterations of the models, which indicated that test selection and model choice in PSW is not arbitrary and may result in inconsistent diagnostic decisions across practitioners and educational agencies. These results are especially troubling given the opaque language in existing SLD statutes which permits a wide degree of latitude in how educational agencies operationalize the PSW model within their jurisdictions. These results indicated that more precise regulatory language is needed as it relates to documenting idiographic strengths and weaknesses consistently across different educational settings. Until these procedures are clarified, large scale studies to document the effectiveness of the PSW model as it is implemented across the state effectively will be useless.

In sum, despite the claims made in the CASP position paper, there is insufficient scientific evidence to indicate (a) a preferred PSW model, (b) a robust methodology for documenting a cognitive weakness, and (c) that use of PSW procedures results in more consistent and defensible evaluative judgements when compared to existing diagnostic procedures (Dombrowski and Gischlar 2014; McGill et al. 2015). We believe that such evidence should be provided before adoption of the model is considered or endorsed.

Critical Assumption Two: Cognitive Profile Analysis Is Reliable and Valid

Because all PSW models emphasize primary interpretation of lower-order cognitive test scores (e.g., factor and cluster scores), it is critical to evaluate the fundamental psychometric properties of these measures. Although factor scores typically possess relatively strong internal consistency and stability coefficients (e.g., ≥0.80) that indicate they are sufficient for individual decision-making (e.g., Wasserman and Bracken 2013), significant questions have been raised about the long-term stability and structural and incremental validity of factor-level measures from intelligence tests (Canivez 2013). Also, it is important to keep in mind that an alpha of 0.80 means that 80 % of the method error variance is accounted for, leaving 20 % or a one in five chance of method error in our decision-making process. Additionally, the potential impact of these error terms on decision-making processes should be regarded as lower bound estimates as all PSW models require simultaneously comparing multiple cognitive-achievement scores simultaneously. Such fishing expeditions have long been known to exacerbate decision-making error (McGrath 2011).

Whereas the psychometric shortcomings of subtest-level profile analysis have long been known (Macmann and Barnett 1997; McDermott et al. 1990, 1992; Watkins 2003), confirmatory factor analysis research that has been used to establish the evidentiary basis for XBA (e.g., Reynolds et al. 2014) has been used to support factor-level profile analysis by proponents of the PSW model. Even so, there is a countering body of evidence that brings into question the primary interpretation of intelligence tests at that level and the validity of the XBA model. Structural validity investigations using exploratory factor analysis have revealed conflicting factor structures from those reported in the technical manuals of contemporary cognitive measures (see Canivez 2008; Canivez and Watkins 2010; Canivez et al. 2015; Dombrowski 2013; McGill 2015; Watkins 2006), which indicates that these instruments may be overfactored (Frazier and Youngstrom 2007). Additionally, the long-term stability and diagnostic utility of these indices has been found wanting (Watkins 2000; Watkins and Smith 2013). More recently, McDermott et al. (2014) found that a significant amount of factor-level variability across long-term retest intervals was attributable to variables that had nothing to do with individual differences (e.g., assessor bias), posing a significant threat to inferences made from cognitive profile data at any one point in time.

Additionally, the emergence of bifactor modeling in the psychometric literature poses questions about the accuracy of procedures (e.g., coefficient alpha) used to estimate the reliability of factor scores on cognitive measures. As an example, Canivez (2014) examined the WISC-IV with a referred sample and found that the factor-level scores were inherently multidimensional (i.e., composed of non-trivial proportions of construct irrelevant variance attributable to the general factor). According to Beaujean et al. (2014), multidimensionality is not the problem per se, the problem occurs when interpretations of individual cognitive abilities and their related composites "fails to recognize that Stratum II factors derived from higher order models are not totally independent of *g*'s influence" (p. 800). Whereas it may be possible for practitioners to account for general factor effects when interpreting primarily at the factor-level, contemporary PSW models have yet to provide a mechanism for doing so (McGill and Busse 2015). As Horn (1991) cautioned long ago, attempting to disentangle the different features of cognition is akin to "slicing smoke."

In sum, these measurement concerns pose significant threats to the validity of the PSW model and must be overcome in order for these procedures to be used successfully in clinical practice because diagnostic decisions based on data obtained from measures that have questionable psychometric properties likely will be flawed (Glutting et al. 2006). As Glutting et al. (2003) remarked over a decade ago "repeated

statements that…approaches are based on contemporary, current, modern, or comprehensive theory do not constitute evidence," (p. 365).

Critical Assumption Three: PSW Methods Have Adequate Treatment Utility

Proponents of the PSW model have consistently claimed that cognitive profile data can be utilized to successfully generate individualized treatment plans for students suspected of having SLD (see Fiorello et al. 2006 for a demonstration). Christo and Jones (2014) stated that the information gleaned from consideration of an individual's cognitive strengths and weaknesses "is useful in educational planning for a student whether he or she is determined to be eligible for special education" (p. 4), implying the presence of an aptitude-treatment-interaction (ATI). However, despite many attempts to validate group by treatment interactions, the efficacy of interventions focused on cognitive deficits remains speculative and unproven (Kearns and Fuchs 2013; Pashler et al. 2009).

Particularly noteworthy, are the findings obtained from a recent meta-analysis of the efficacy of academic interventions derived from neuropsychological assessment data by Burns et al. (2016). In contrast to the effects attributed to more direct measures of academic skill, it was found that the effects of interventions developed from cognitive data were consistently small ($g = 0.17$). As a result, Burns et al. (2016) concluded, "the current and previous data indicate that measures of cognitive abilities have *little to no* [emphasis added] utility in screening or planning interventions for reading and mathematics" (p. 37).

As previously mentioned, PSW proponents often rely on results from case studies to justify the treatment validity of these procedures. As an example, Fiorello et al. (2006) administered a battery of 11 cognitive measures to a child who demonstrated difficulties with attention, behavioral control, and word reading. Based upon the pattern of scores that was obtained, the authors recommended a treatment program that consisted of a phonological awareness intervention and a psychoactive stimulant medication trial which successfully remediated the referral concerns.

Whereas the authors concluded that this was an example of cognitive assessment data informing intervention, we suggest a more circumspect appraisal. For one thing, practitioners must bear in mind that attempts to use cognitive profile data to causally explain established referral concerns violate scientific logic in the form of the post hoc ergo propter hoc fallacy – the 'I knew it all along' fallacy of confirmation bias despite empirical evidence that challenges the supposition (Meehl 1973) and raise the threat of making an *illusory correlation*—the false belief that two variables are related (Chapman and Chapman 1967). Considerations of such threats to diagnostic decision-making are especially important given the fact that cognitive strengths and weaknesses are typical in the population. As stated by Flanagan et al. (2011), "Most individuals have statistically significant strengths and weaknesses in their cognitive ability and processing profiles…Therefore, statistically significant variation in cognitive and neuropsychological functioning in and of itself must not be used as de facto evidence of SLD" (p. 242). In short, we suggest it has yet conclusively to be established within the professional literature whether PSW procedures provide users with clinical acumen or, to the point, clinical illusion (Floyd and Kranzler 2013; Watkins 2000).

Even more importantly, given the fact that the interventions implicated from the test data in the study are consistent with best practice based upon the known referral concerns, it is worth considering whether these same interventions could have in fact been suggested from less intrusive and cost intensive procedures (e.g., observations, diagnostic interviews, and brief phonological screening measures). In consideration of these issues, Floyd and Kranzler (2013) characterized the continued search for ATI as a "hall of mirrors" (p. 240) and encouraged practitioners to "just say no" to the assessment of specific cognitive abilities for the specific purpose of differentiating instruction.

Conclusion and Future Directions

In 2014, Christo and Jones provided CASP members with a position statement and summary of SLD assessment procedures. Although the authors of the position paper stated that adoption of PSW as an SLD identification and treatment model is *evidence-based*, such prescriptive statements in education and psychology are rarely justified and require high standards of empirical evidence (Marley and Levin 2011). As we hope we have demonstrated, even a cursory review of the relevant empirical literature indicates that a more cautious appraisal of the potential clinical utility of the PSW model is warranted. As Fletcher et al. (2013) stated, "It is ironic that methods of this sort [PSW] continue to be proposed when the basic psychometric issues are well understood and have been documented for many years" (p. 40).

It is worth noting that many of the positions taken within the CASP document are consistent with those articulated in the Hale et al. (2010) white paper. However, a critical response paper authored by the Consortium for Evidence-Based Early Intervention Practices (2010) indicated that 73 % of the 117 citations contained within that white paper represented non-empirical book chapters, commentary articles, and literature reviews written by one or more of the authors. Selective review of the literature may create the illusion that a preferred theory is well confirmed, a potential warning sign of confirmation bias wherein one only looks at cases or examples that are in line with established and/or personal preferences and beliefs (Nickerson 1998). When appraising the validity of models suggested for SLD identification, we

encourage practitioners and school psychology trainers to be mindful that a successful theory and/or hypothesis must explain all relevant data and not merely the examples that are favorable to a particular position (Lilienfeld et al. 2012).

Beyond the issues that we raised about the validity and utility of the PSW model, significant questions remain about the construction of the actual document itself given that the position paper may influence the practices of CASP members and, perhaps more importantly, may influence school district implementation of SLD practices and department of education agencies that set policy and guide legislation within California and elsewhere. In the lead up to the publication of the document, we were not aware of any attempt to poll the broader CASP membership regarding their beliefs on the potential efficacy of the PSW model or the need for its adoption thus the representativeness of the positions articulated in the paper is presently unknown. Whereas we stipulate that, for ill or good, it is likely that a majority of practitioners and trainers may endorse these methods, the critical questions we have raised throughout this article remain.

Whereas, admittedly, our goal was to briefly review the tenability of the critical assumptions made in the CASP position paper and by others in the literature who espouse the PSW approach, we believe that the questions that we raise are sufficient for stimulating a more balanced discussion within the discipline of school psychology about the validity and clinical utility of the PSW model. We stipulate that the PSW model has intuitive appeal from a theoretical standpoint and that there is anecdotal and correlational evidence to support some of the assertions made by its proponents. However, as recommended by a peer reviewer of this article, we believe that it would benefit PSW researchers to obtain grant funding through appropriate sources (e.g., federal agencies, non-governmental organizations) and establish partnerships with multiple research universities to implement pilot models throughout the state so that efficacy data can be obtained to determine the degree to which (a) PSW models can be implemented with integrity and scaled-up for widespread adoption; (b) PSW data provide for reliable and valid evaluative decisions for students suspected of having SLD in comparison to rival methods (e.g., RTI); and (c) the degree to which data obtained from these models are useful for treatment planning and result in positive treatment effects.

In conclusion, we are mindful that there will be practitioners and researchers who disagree with many of the points we raised in this article. We believe that fundamental disagreements that are produced from divergent theoretical orientations are vital to advancing the field of school psychology. Despite the concerns we raised within the present review, the authors of the CASP position paper should be commended for raising a number of legitimate issues with the sole use of any one particular method for SLD identification, and for their apparent desire to promote practices that may benefit the children we serve. Nevertheless, legitimate questions have been raised in the technical literature about the PSW model that we believe were not adequately addressed in the position paper. According to Lilienfeld et al. (2015), a basic tenet of science is that the burden of proof rests with the person making the claim; as a consequence it is up to the proponents of the PSW model to demonstrate the reliability and validity of these techniques *before* adopted as part of our daily practice.

We are cognizant of the importance of these issues and the application to practice, and the desire to put into place procedures to meet the needs of our charges. Apropos, we as a field must be vigilant and use evidence-based practices as we make decisions regarding children's lives. In particular, we urge the field of school psychology (and other fields) to engage in *evidence based assessment*. We hope this article will engender further debate, research, and discussion regarding the PSW model and its applications within and beyond California. SLD, as with many other issues in school psychology, is a "fuzzy construct" and ill defined. At this point in our understanding, the technology is advancing but the current trend toward theories which are largely based on the XBA movement have yet substantively to move beyond theory and to stand up to the test of science (Canivez 2013; Glutting et al. 2003). More importantly, we suggest that the adoption of the PSW model in its present mode may be a disservice to the children we serve and perhaps should not be implemented until much more data are gathered.

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