
Benefits and pitfalls in the merging of disciplines: The example of developmental psychopathology and the study of persons with autism

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Abstract

Recent advances in the discipline of developmental psychopathology highlight the contributions of developmental thought to the study of persons with autism. This article briefly outlines primary developmental innovations in theory, methodology, and the interpretation of findings. Specifically, we discuss two sets of issues that arise from the general notion of developmental level. One set is relevant to the choice of persons that comprise the comparison group and the other to the various implications of the subjects' levels of functioning. In sum, we contend that researchers need to frame their empirical work within the context of developmental theory and methodology and interpret their findings accordingly. This will lead to scientifically compelling work and an increasingly heuristic approach to the study of persons with autism.

The emergence of the discipline of developmental psychopathology, like other beginnings and births, was heralded with considerable excitement and visions of future accomplishment. The formal inauguration was highlighted by persuasive arguments for the necessity and benefits of focusing on the reciprocally informative relationship between developmental theory and the study of psychopathology (Burack, 1997; Cicchetti, 1984,

1990; Rutter & Sroufe, 2000; Sroufe & Rutter, 1984). The subsequent development and identity of the discipline is marked by the advent of the specialized journal *Development and Psychopathology* and the publication of volumes dedicated to the field in general (e.g., Cicchetti & Cohen, 1995; Luthar, Burack, Cicchetti, & Weisz, 1997) and specific topics within (e.g., Burack, Hodapp, & Zigler, 1998; Cicchetti & Beeghly, 1990; Zigler & Glick, 1986). Consistent with Werner's (1957) orthogenetic principle of development, these milestones reflect the ongoing differentiation and integration in the developing field as specific subdisciplines and foci of interests are delineated but still subsumed within the larger theoretical framework.

The success of the discipline is further evidenced by the impact of the emergent field on its ancestors, particularly those of development and psychopathology (and among related fields such as special education and

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psychiatry), because issues of developmental psychopathology are now commonly addressed in their publications and at conferences. Mainstream developmentalists are increasingly aware that the development of persons who are atypical because of disorder, life history, living situation, or other reasons that might put them at risk provides examples of “experiments in nature” and “testing the limits” that are uniquely informative to understanding the boundaries of typical development (Hodapp & Burack, 1990). Similarly, those interested in atypical populations are cognizant that developmental guidelines provide insight about the occurrence and severity of delays, deviance within specific populations, or both (e.g., Hodapp & Zigler, 1995; Iarocci & Burack, 1998; Mervis & Robinson, 1999).

However, it is typical of development that the course of maturation of the new discipline presents challenges; this might be especially expected with an offspring of origins as divergent as those of development and psychopathology. In this case, the coalescence of contrasting world views and empirical frameworks, although largely beneficial and informative, is replete with difficulties in its application to empirical methodology and interpretation (Burack, 1997). The success in addressing and resolving these issues will play a vital role in the continued emergence of the identity and acceptance of developmental psychopathology as a separate discipline. However, this may involve some reconsideration of accepted tenets. As with all development, the breaking down of structure is a preliminary step for the restructuring of even more advanced attainments. Thus, the initial excitement surrounding the birth of the new discipline needs to now be accompanied by some self-reflection on the part of its adherents. In this paper we undertake this endeavor with specific regard to the study of persons with autism. We highlight contributions of the developmental psychopathology perspective and identify problems relevant to various aspects of research.

Autism and Developmental Psychopathology

The study of autism is particularly influenced by the advent of developmental concepts and

methodologies because the nature of the disorder is integrally related to developmental issues. Autism is generally evident by the second year of life and pervades every aspect of subsequent development. For developmentalists the most striking characteristics are the unusual profiles of development that include marked deficits in communication, social adaptation, and imagination but strengths in subcomponents of visual-spatial functioning (Mottron, Belleville, & Ménard, 1999; O’Riordan, 2000; O’Riordan, Plaisted, Baron-Cohen, & Driver, 2001; Plaisted, O’Riordan, & Baron-Cohen, 1998a, 1998b). In addition to these atypical profiles of development, the majority of persons with autism manifest a general developmental delay (Hobson, 1991; Sigman, 1996). Although these and related aspects of impaired functioning among persons with autism were formerly discussed primarily with regard to “deviance,” they are now studied within a general framework of development that necessitates consideration of developmental rates, sequences, and relationships across domains (Volkmar, Burack, & Cohen, 1990).

Among developmental issues, the role of developmental level is most commonly cited in research on autism. It is relevant to matching the target group of persons with autism and one or more comparison groups that comprise persons with other kinds of atypicalities, typically developing persons, or both (Burack, 1994; Hobson, 1991; Sigman & Ruskin, 1999). The developmental level is also essential to understanding the relevance of specific findings because each developmental level is characterized by specific salient developmental issues and histories that are often quite different from those at other levels (Sroufe & Rutter, 1984). This is important for at least two reasons: group differences and similarities may be seen at one or more developmental levels but not at others, and the current and long-term effects of specific problems are largely determined by the developmental level. Problems at one point in development may be less relevant or even inconsequential at another (Burack, 1997). Thus, the finding of no difference simply means that no differences are found with the specific tasks at the specific developmental level of the subjects.

This does not preclude group differences at other developmental levels or with other tasks that tap the same domain of functioning. Findings of no group differences do not ensure that the processes and mechanisms used to complete the specific tasks function in the same way, with the same level of efficiency, or even that they are the same.

Although issues of development are often cited in studies of autism and matching by developmental level is now commonplace, the implications of developmental contributions to the methodology and theory of research about persons with autism still need to be clarified. In this paper we present two sets of issues that are integral to developmental research on persons with autism. One set is relevant to the choice of persons that comprise the comparison groups and the other is relevant to the various implications of the subjects' developmental levels at the time of testing.

The Matching Issue

The use of comparison groups is essential to evaluating the outcome of any research about a specific population. The choice of groups provides a framework for understanding whether performance is typical or atypical and whether any atypicality is unique to the specific group. Wagner, Ganiban, and Cicchetti (1990) referred to the questions of "normalcy" and "uniqueness" to delineate the types of comparisons that can be made when studying an atypical population. They explained that typical populations are used as comparison groups in order to address the question of normalcy: is the performance of the target group similar to that of the typical population? Conversely, the question of uniqueness—is the performance of the target group only seen with this particular population?—can only be addressed when other atypical populations are included as comparison groups.

The "normalcy" question

The choice of the comparison group for the normalcy question is relatively straightforward in studies of higher functioning persons with autism and average IQ who can be com-

pared to typically developing persons of the same chronological age, although issues of comorbidity with psychiatric, medical, and language disorders (Volkmar, Klin, & Cohen, 1997) and uneven and inconsistent cognitive profiles (Motttron & Burack, 2001; Sparrow, Marans, Klin, Carter, Volkman, & Cohen, 1997) need to be considered. The relatively common occurrence of comorbid disorders necessitates the exclusion of persons with autism and one or more other disorders (e.g., hyperactivity, depression) from studies in which autism per se is the focus. Uneven cognitive profiles necessitate the use of comparison groups that are typically matched on specific criteria such as the verbal or performance subscales of traditional IQ tests rather than on general measures of IQ. However, even this microanalysis of developmental level is problematic because persons with autism typically display "spikes" of both superior and impaired performance on the various tests or components of these subscales. For example, tests such as the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997) and British Picture Vocabulary Test (Dunn, Dunn, Whetton, & Pintillie, 1982) are commonly used for matching on verbal mental age in studies of persons with autism, although the scores of persons with autism, especially those of the Asperger subtype, tend to be inflated on this as compared to other verbal measures. Accordingly, the use of a general subscale score may be appropriate for matching purposes when the foci of study are more general verbal or performance processes and matching on a specific subscale may be more suitable for narrower foci of study. This more fine-grained approach is also helpful in accounting for the inconsistencies across high-functioning persons with autism, who display a considerable degree of within-group heterogeneity in spikes of performance on various subtests of both the performance and verbal subscales (Siegel, Minschew, & Goldstein, 1996).

Matching strategies are further complicated in the study of the majority of persons with autism, for whom the disorder co-occurs with mental retardation. As in the study of nonautistic persons with mental retardation, the question of normalcy for lower functioning persons with autism cannot simply be

whether they perform worse than their typical peers. Any findings of deficits may be the consequence of this generally slowed rate of development rather than of autism per se: by definition, lower functioning persons will be found deficient on most tasks if compared to typically developing persons of the same chronological age. Therefore, more meaningful normalcy questions need to be formulated within the context of expectations for the subjects' particular levels of development (Hobson, 1991; Prior, 1979).

The simplest question pits the performance of persons with autism against that of mental age (MA) matched, typically developing children. This commonsense strategy is an obvious solution for alleviating the inherent problem that the lower functioning group, almost by definition, will be expected to perform worse than chronological age (CA) matched peers in any area of functioning. By equating groups of subjects on some general level of functioning, researchers can determine which areas of functioning are intact with regard to the overall level of development and which are problematic even when the general delay is taken into account (Hodapp, Burack, & Zigler, 1990).

As is the case in all studies of persons with mental retardation, MA matching of persons with autism functioning in the lower ranges of intellectual ability with typically developing children is problematic because of the inherent group differences in CA (Mervis & Robinson, 1999; Sigman & Ruskin, 1999). Groups of chronologically younger, typically developing and older, lower functioning persons matched on MA necessarily differ with regard to a variety of factors relevant to biological maturation and life experiences that can affect performance in a variety of ways (Evans, Hodapp, & Zigler, 1995). The alternative of only using a CA-matched typical group is obviously unacceptable because the groups would by definition function significantly differently on the general level of functioning. The use of a CA-matched group in addition to a group matched on the developmental level is a possible strategy, but it is unlikely to be informative in most cases. Tasks that are challenging for the target group

are likely to be simple for the CA-matched peers of average intelligence, and tasks that are challenging for this comparison group are likely to be too difficult for the target group.

A second possible normalcy question involving lower functioning persons with autism entails comparisons with a normative group of persons with the same IQ and CA; in this case, the comparison group comprises persons with mental retardation. Ideally, this strategy eliminates concerns about the effects of group differences with regard to the rate of development (i.e., IQ) and CA that occur when lower functioning and typically developing persons are compared (Sigman & Ruskin, 1999). However, the effectiveness of this strategy is undermined in the real world because there is no "normal" population of persons functioning in the range of mental retardation. Persons with mental retardation are a heterogeneous population because they suffer from hundreds of different etiologies, each of which may be associated with a unique profile of development (Burack, 1990; Burack, Evans, Klaiman, & Iarocci, 2001; Burack, Hodapp, & Zigler, 1988; Dykens & Hodapp, 2001; Tager-Flusberg, 1999). For example, people with Williams syndrome display relative strengths in lexicon, linguistic affect, auditory short-term memory, facial recognition, and musicality, but relative weaknesses in mathematical cognition, visual-spatial functioning, and perceptual planning (Dykens, Hodapp, & Finucane, 2000). In contrast, persons with Down syndrome show relative strengths in visual-spatial functioning and weaknesses on verbal tasks (Reilly, Klima, & Bellugi, 1990). Thus, the use of available groups of persons with mental retardation can lead to different conclusions of normalcy, because the etiologies, and therefore the behaviors, of the persons who comprise the comparison groups differ.

The significance of the choice of comparison group is reflected in the finding that on certain conditions of a visual attention task, persons with autism (mean MA of approximately 8 years) performed worse than MA-matched persons with familial mental retardation but similar to MA-matched persons with organic mental retardation (Burack, 1994).

Similarly, children with autism and an MA of approximately 2 years displayed a similar number of functional play acts compared to a matched etiologically heterogeneous group of children with developmental delays but fewer than a matched group of children with Down syndrome (Sigman & Ruskin, 1999). In both cases, conclusions about the normalcy of the behavior of the persons with autism that are based on findings with one comparison group would be incompatible with those based on evidence from the other. Similarly, merging the comparison groups would obscure the differences between them and the implications for comparisons with persons with autism.

Developmental considerations in the use of standardized tests. Regardless of whether the target subjects function in the range of mental retardation or in the normal range, the matching process is complicated by the diminished efficacy of standardized tests for establishing commensurate MA levels between persons with autism and those in the comparison group (Mervis & Robinson, 1999; Sigman & Ruskin, 1999). The use of standardized tests is problematic for reasons stemming from the unique behavioral profile of persons with autism that is characterized by marked strengths and weaknesses across domains of functioning (Hobson, 1991; Klin & Volkmar, 1997). This complicates the matching process because it diminishes the utility of the simpler notion of general developmental level. For example, the discrepancy between limited communication skills and certain nonverbal abilities suggests that highly verbal tests will underestimate the level of cognitive functioning among persons with autism but overestimate for persons with Asperger syndrome. Nonverbal tests, such as the Leiter International Performance Scale, may overestimate the cognitive ability of persons with autism because the tasks involve visual-spatial functioning, an area of relative strength in this group (Shah & Frith, 1993). The implications of the discrepancies among matching measures is evident in the finding that the emotion perception of persons with autism, compared to that of typically developing persons, is impaired when the groups are matched on non-

verbal MA but not when they are matched on mean length utterance (Ozonoff, Pennington, & Rogers, 1990). With this type of evidence the notion of matching can no longer be seen as some definitive method for evaluating group strengths and weaknesses, but rather as a context for comparing levels of performance among domains of functioning. Questions might be refocused on performance in the target area of functioning in comparison to other specific domains rather than to the general developmental level.

The discrepancies associated with the various matching measures reflect that the choice of appropriate measures for matching and comparison cannot be viewed solely within the context of better or worse but must be considered with regard to the specific subject characteristics and research questions. Each solution entails weaknesses, and none can be applied to all populations and studies. The most common strategy is the use of a general (full scale) IQ score that provides some intermediate measure between those from subtests with typically high (e.g., Block Design and Object Assembly) and low scores (e.g., Comprehension). Although it is a reasonable approach, the importance of the relative strengths and weaknesses among persons with autism diminishes the utility of a composite, or compromise, score. If matching is based on a compromise score but performance on the specific task is dependent on functioning within a broad domain of weakness, then the matching measure overestimates the abilities of the persons with autism. In this scenario they are compared to persons who function at a higher level for that domain of functioning and therefore are more likely to show impaired performance on the specific task. Conversely, if performance on the specific task is based on functioning in an area of strength among persons with autism, they are likely to display enhanced performance compared to MA-matched, typically developing persons. The considerations of these uneven patterns of development lead to the more precise question of whether performance on the experimental task is enhanced (or diminished), even within a general area of strength (or weakness). For example, Plaisted et al. (1998b)

found that persons with autism were more accurate than nonautistic persons in detecting conjunctive targets on a visual search task, which is evidence of superiority, even within the generally enhanced area of visual-spatial processing.

The use of multiple groups of typically developing persons, each of which is matched to the persons with autism on a different measure of development, is one alternative to the idea of a “single” comparison group (Hobson, 1991). This strategy allows for increased precision in evaluating the level of functioning in the specific domain within a more comprehensive developmental framework. Functioning in the domain of study can be charted against each of the developmental criteria, which can be either general or specific indexes as deemed appropriate by the researchers. For example, performance on a specific (e.g., theory of mind or ToM) task among persons with autism can be compared to that of typically developing comparison groups matched on measures of receptive language, expressive language, general language functioning, or general IQ. The age of the comparisons groups will vary, depending on the matching measure; accordingly, the identification and severity of impairments (or strengths) will likely vary among the various comparisons. Increasing the number of comparisons leads to a more precise understanding of the level of functioning in the specific domain within the contexts of developmental strengths and weaknesses but also leads to greater demands on researchers.

The “uniqueness” question. By definition, behavioral disorders or syndromes are clinically defined by specific profiles of functioning that are in some ways different from the typical population (the normalcy question) and from other clinical populations (the uniqueness question; Wagner et al., 1990; Zelazo, Burack, Benedetto, & Frye, 1996). Thus, groups are differentiated by specific problems in one or more areas of functioning. Even when disorders are considered pervasive, with the possible exceptions of general intellectual delay seen among some groups of persons with mental retardation of unknown etiology,

they are distinguished from each other by characteristic profiles of behavioral functioning (Hodapp & Zigler, 1995; Zigler & Hodapp, 1986). These differences may be at a macrolevel in which primary deficits reflect some general problem in the cognitive, social, or emotional domains, or at more microlevels in which the differences are in more specified subdomains, or even sub-subdomains, of functioning (Burack, 1990; Dykens et al., 2000).

The distinct developmental profiles of the groups complicate the matching of any two or more groups (Burack, 1997; Mervis & Robinson, 1999). As discussed, any measure of general developmental level is simply a composite of disparate levels of functioning across domains. Thus, if the domain of study is a relative strength for persons with autism, then matching on a general developmental level will entail that the comparison subjects will perform at a lower developmental level on the target domain. The converse is true if the focus of study is an area of relative weakness among persons with autism because the comparison group matched on the general developmental level will function at a higher developmental level on the specific task. As in the case of the normalcy question, one strategy is to match the groups on a measure that is related to the ability that is being tested, for example, the use of a nonverbal reasoning measure with visual-spatial skills when comparing performance on a task of visual attention. The likelihood of finding group differences is minimized in this case. However, the advantage is increased confidence that the evidence of either impaired or superior performance is an accurate reflection of developmental level specific to the target skill and is not simply the consequence of more general weaknesses or strengths.

For purely logical reasons, the strongest form of the uniqueness question—is the specific behavior or pattern of behavior found only in the target group?—can never be answered definitively until every possible population and subpopulation is tested. However, direct comparisons of groups that are clinically similar in certain domains can be informative for identifying defining characteristics of the target group. Within this context, spe-

cific clinical groups of children with developmental language disorder (DLD) or Fragile X syndrome are potentially informative comparison groups because they uniquely resemble persons with autism in certain characteristics, although differences must also be considered. For example, children with DLD resemble a subgroup of persons with autism with regard to cognitive profiles because their verbal impairments lead to lower scores on the verbal subscale compared to the performance subscale of the Wechsler Intelligence Scale for Children (WISC, Mawhood, Howlin, & Rutter, 2000). However, the patterns of language impairments differ between the two groups in that phonology and syntax are intact among persons with autism but not in those with DLD whereas semantic and pragmatic aspects of language are more likely to be impaired among persons with autism. Thus, comparisons with persons with DLD are appropriate when general scores of verbal abilities are appropriate but may be less so when matching is for more precise aspects of language ability. Similarly, persons with Fragile X syndrome and persons with autism exhibit comparable weaknesses in the social–communicative domain (for a review, see Loveland & Tunali–Kotoski, 1998), so the inclusion of a comparison group of persons with Fragile X syndrome may be helpful specifically in studies of social functioning. In these types of scenarios the comparison groups allow for more precise differentiation between performance in the target area and in the more general domain of functioning, although researchers need to ensure that persons with both Fragile X and autism are excluded from the comparison group. Evidence of deficits that are either unique to or most severe among persons with autism would be at least preliminary evidence for a problem that is specific to autism and is not a consequence of an overall delay in the general domain of study.

However, the implications of research based on comparisons between persons with autism and another specific group are diminished with regard to widespread generalizability. For example, the precise comparison of the performances of persons with autism and those with Down syndrome, as between any

two or more specific groups, is limited because the findings are unique to those specific populations and bear few, if any, implications beyond the specific groups (Yirmiya, Erel, Shaked, & Solomonica–Levy, 1998). The performance of persons with Down syndrome is not representative of that of all persons with mental retardation, thereby precluding any conclusions regarding performance of persons with autism as compared to that of persons with mental retardation per se. Similarly, the study of persons with autism in relation to those with DLD entails a unique comparison between two populations with specific language disorders that is not relevant to more generalized issues. Despite these inherent limitations, comparisons among specific atypical groups are necessary for precise conceptualizations of various disorders. For example, comparisons of subcomponents of executive function among persons with attention-deficit hyperactivity disorder (ADHD) compared to those with autism revealed a dissociation between impulsivity (impaired among persons with ADHD) and planning (impaired among persons with autism; for a review, see Pennington & Ozonoff, 1996).

Issues of Developmental Levels of the Participants

Assessments at different ages and levels of functioning are central to creating a comprehensive picture of development across domains of behavior. This type of comprehensive charting is necessary because certain problems are apparent at one developmental level and not at another (Enns & Burack, 1997; Sroufe & Rutter, 1984). In some cases the deficit is evident at an early level of functioning but not later in development because the task is eventually mastered. For example, people with visual impairment typically display language problems before the age of 3, but a substantial number of these people show typical language later in childhood (McConachie & Moore, 1994). Similarly, impairments in language are integral to diagnosis among high functioning persons with autism before the age of 3 years, yet the syntactic and lexical components improve to the extent that

they are similar to those of typical children by the age of 5 or 6 years (APA, 1994). In other cases development appears typical at young ages, when all that is required are simple abilities and behaviors that are indicative of lower developmental levels, but it is deficient with more sophisticated and complicated tasks that reflect higher developmental levels. Language problems among children with Asperger syndrome are not identified before the age of 3 years (Landa, 2000), whereas abnormalities in the social utilization of language that begin shortly thereafter and continue through the life span are an integral component of diagnosis (APA, 1994).

Certain symptoms persist in development but change in form over time. One manifestation of the restricted interests and repetitive behaviors area is the preoccupation with parts of objects (DiLavore, Lord, & Rutter, 1995). This is evidenced among younger or nonverbal lower functioning persons by compulsive examination of certain physical dimensions of objects (e.g., edges) and rotation of objects. Concordantly, verbal higher functioning persons often display an intellectual interest in restricted domains of knowledge, such as trains and metallurgy, that are the object of constant mental manipulations (DiLavore et al., 1995). These developmental changes in symptomatology are exemplified in the personal history of a high functioning person with Asperger syndrome, who as a child obsessively watched the rotation of hands on a watch and similar objects and as an adult developed computer software to calculate the number of seconds elapsed since the millennium at any time in any day (Mercier, Mottron, & Belleville, 2000).

The consideration of changes in the developmental course of the disorder are essential to biological and neurological considerations. This is consistent with the notion that typical brain development proceeds through a cascade of numerous processes that bootstrap on each other. Interruption or simple delay during critical periods would significantly affect the final neural components and their assembly into a functional whole (Zimmerman & Gordon, 2000). Within this type of framework, Zilbovicius, Garreau, Samson, Remy, Barthélemy, Syrota, and Lelord (1995)

found that developmentally delayed children with autism at the ages of 33–52 months showed a bilateral frontal hypoperfusion on a single photon emission computed topography (SPECT) equivalent to that seen among typical infants at approximately 19 months but not among their CA-matched, typically developing peers. However, this physiological impairment was not evident 3 years later, suggesting that it may be transient, although the deleterious outcome may extend later into the life span (Zilbovicius et al., 1995). Thus, even biological anomalies need to be considered within the context of developmental level of functioning because group differences on the SPECT may not be the specific sequelae of autism per se, but rather of delayed development.

Developing studies to chart change over time

Understanding the unique relationship between specific problems or disorders and relevant aspects of development entails longitudinal or a series of cross-sectional studies in which functioning is considered at various developmental levels. The utility of these strategies is highlighted by larger improvements in the areas of communication and social behaviors compared to ritualistic and repetitive behaviors among high IQ adolescents and adults with autism (Piven, Harper, Palmer, & Arndt, 1996).

The developmental level at the time of identification of the problem is integral to predicting behavioral sequelae and outcome because a deficit or delay in a specific area of behavior may be manifested in several different ways throughout development (e.g., Burack, 1997). In this scenario the long-term or cumulative effects of an early cognitive processing problem may lead to profound deficiencies or delays in any number of domains of functioning, including those not obviously related to the original problems. For example, MA among children with autism predicts gaze following abilities (Leekam, Hunnisett, & Moore, 1998; Leekam, Lopez, & Moore, 2000; Leekam & Moore, 2001) that are considered to be associated with ToM and later developing social skills (Mundy, 1995;

Mundy, Sigman, & Kasari, 1994). Similarly, problems in other areas may be precursors to later deficiencies or delays in cognitive functioning (Sroufe & Rutter, 1984). For example, a lack of interest in social interactions among persons with autism may be one source of deficits in face discrimination and may even be a factor in altered cortical activity on this type of task (Schultz et al., 2000). Within the ever-evolving complex web of interrelated internal and external components of the developing systems, significant deviations from the norm are likely to have far reaching and enduring consequences. Thus, a deficit or delay in a domain of functioning, such as joint attention, that typically emerges in infancy may be related to either later problems in similar areas of attentional functioning or those in more remotely related areas of development, such as the ability to engage in reciprocal social interactions (Sigman & Ruskin, 1999). Concordantly, the preservation of a single cognitive ability, such as musical or basic pattern perception, at a typical level of functioning may interfere with the long-term development of other already delayed skills (Mottron, Limoges, & Jelenic, in press).

Within a developmental framework, the extent of impairments in performance among a specific group of persons, such as those with autism, can be understood within the context of developmental delay. Delays are identified by a level of functioning that is lower than that expected by CA or MA but still related to them in some consistent and systematic way (Burack, 1992; Cicchetti & Pogge-Hesse, 1982). In general developmental delay the levels of functioning across domains are lower than among same-CA peers of average functioning but commensurate with same-MA persons. However, in common examples of specific developmental delay, successful performance on a task is not completed until considerably later than typical. The extent of the delay is informative about the severity of the impairment and the extent to which it might affect other aspects of functioning. For example, first-order theory of mind tasks, which are completed successfully by typically developing children by the ages of 3–5 years, are attained by persons with Down syndrome after some delay, by other groups of persons

with mental retardation after a greater delay, and by persons with autism after an even greater delay (Yirmiya, Erel, Shaked, & Solomonica-Levy, 1998). Accordingly, a delay in ToM cannot, as often cited, be considered unique to persons with autism. Rather, the discussion of uniqueness must focus on the severity of the delay for which the cognitive and social implications may be quite different than in initial conceptualizations.

The theoretical and methodological implications of the severity of delay or impairment are also relevant to differences among persons with autism. Thus, performance on complex cognitive tasks by high functioning adults with autism is not relevant to lower functioning persons who never attain commensurate developmental levels. For example, considerations of deficits on second-order ToM tasks may be inconsequential for understanding the functioning of lower functioning persons with autism who never solve more basic, first-order ToM tasks (Baron-Cohen, 1989). In addition to group discrepancies in the level of functioning in a general sense and on specific tasks, persons with autism at higher and lower developmental (MA) levels differ with regard to developmental profile. Consistent with developmental notions, the types and severity of strengths and weaknesses likely differ at disparate levels of functioning. A further confound is the likelihood that profiles of development may not even be consistent for different groups of persons at the same developmental level but with different IQs. If IQ differences are related to different profiles, then findings for younger, higher functioning persons and for older, lower functioning persons may not be relevant to each other, even when their general levels of functioning may be similar. These inherent and potential problems related to general developmental level and IQ limit the implications of findings from one subgroup to the entire population of persons with autism.

Interpreting nonsignificant findings

The developmental premise that groups of persons matched on mental age should show similar abilities, levels of performance, or

both on many aspects of functioning led to an interest in studies of nonsignificant findings in which no differences are found between the persons with autism and their matched peers. In areas of suspected deficit the findings of no differences with appropriate matching suggest that the apparent problem may be an artifact of the generally delayed development among lower functioning persons with autism or a function of some broader area of difficulty. However, the failure to find differences between groups matched at a certain MA does not preclude the possibility of a syndrome-specific problem; rather, it denotes that at a certain point (or points) in development the groups do not differ on a specific task.

The relevance of findings of no differences is contingent on two basic developmental premises. The first issue is that showing no differences at one or a few points in development is not sufficient. Rather, the task is to show that differences were never apparent between the groups. The finding that persons with autism at MA levels of around 10 years do not display deficits on ToM tasks (Dahlgren & Trillingsgaard, 1996) does not diminish the implications of deficits among persons with autism on ToM tasks at MAs between 3 and 5 years when ToM typically emerges (for reviews, see Baron-Cohen et al., 2000; Yirmiya et al., 1998). Accordingly, researchers need to consider functioning across a wide range of developmental levels, especially those concurrent with and after the emergence of the ability in typically developing persons, because that is when differences are most likely to be apparent.

A second issue is that an argument of no differences is contingent on evidence that similar performance on a task reflects similarities in the efficiency and integrity of the underlying processes. Regardless of when in development the behavioral outcome appears typical among persons with autism, the underlying processes and/or mechanisms may not be identical to those seen in typically developing children of that developmental level. The considerably delayed attainment of a particular ability may be due to the individual's capacity to compensate for his or her weakness by using some alternative strategy or skill

rather than by actual attainment of that skill. In this case the behavioral outcome of similar performance does not accurately reflect the underlying processes or the inherent impairments that delayed acquisition of the skills.

Summary

With the advent of the discipline of developmental psychopathology, the study of persons with autism, as well as those with other disorders, was transformed considerably by the introduction of theory and methodology from developmental psychology. In this article we briefly outlined some of these developmental contributions to theory, methodology, and interpretation in research about persons with autism and identified some of the problems inherent in merging the studies of development and those of an atypical population, such as persons with autism. We do not suggest or believe that there is only one way to think about or carry out this type of research. Rather, we contend that the leap from empirical evidence to broad-based conclusions about the disorder, especially with regard to the search for core symptoms, is inherently problematic.

In the quest for greater empirical precision, methodology needs to be crafted to address specific research questions, and the findings must be subsequently interpreted within the constraints of both the questions and the methodology. For example, initial excitement surrounding claims for ToM as the core symptom of autism were tempered in response to findings that performance on ToM tasks among persons with autism is related to other aspects of functioning (Frye, Zelazo, & Burack, 1999; Peterson & Bowler, 2000), ToM tasks are accomplished by persons with autism at higher MAs (Dahlgren & Trillingsgaard, 1996), sophistication of ToM-based justifications for actions is associated with verbal MA (Bowler, 1992), and ToM deficits are evident among other atypical populations (Yirmiya et al., 1998; Zelazo et al., 1996). Within this scenario, the mandatory questions need to be focused on specific aspects of ToM and related areas of functioning for persons with autism at a certain developmental level

and in relation to specific comparison groups. This leads to empirical stories that are less grandiose but more scientifically precise and inevitably to increasingly heuristic and collaborative research in which studies will be designed to complement one another in charting the developmental patterns of persons with autism.

Our identification of problems for the study of persons with autism is not intended as a critique of the discipline of developmental psy-

chopathology; rather, it as an attempt to contribute to its development by addressing issues that arise in the course of its maturation. These are issues that we and all of our colleagues wrestle with on a daily basis. Accordingly, we hope that the questions we raise here will engender ongoing discussion of issues relevant to the discipline of developmental psychopathology and the study of persons with autism and other relevant populations.

References

- American Psychological Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- Baron-Cohen, S. (1989). The autistic child's theory of mind: A case of specific developmental delay. *Journal of Child Psychology and Psychiatry*, 30, 285–297.
- Baron-Cohen, S., Tager-Flusberg, H., & Cohen, D. (Eds.). (2000). *Understanding other minds: Perspectives from developmental cognitive neuroscience* (Vol. 2). Oxford: Oxford University Press.
- Bowler, D. M. (1992). "Theory of mind" in Asperger's syndrome. *Journal of Child Psychology and Psychiatry*, 33, 877–893.
- Burack, J. A. (1990). Differentiating mental retardation: The two group approach and beyond. In R. M. Hodapp, J. A. Burack, & E. Zigler (Eds.), *Issues in the developmental approach to mental retardation* (pp. 27–48). New York: Cambridge University Press.
- Burack, J. A. (1992). Debate and argument: Clarifying developmental issues in the study of autism. *Journal of Child Psychology and Psychiatry*, 33, 617–622.
- Burack, J. A. (1994). Selective attention deficits in persons with autism: Preliminary evidence of an inefficient attentional lens. *Journal of Abnormal Psychology*, 103, 535–543.
- Burack, J. A. (1997). The study of atypical and typical populations in developmental psychopathology: The quest for a common science. In S. S. Luthar, J. A. Burack, D. Cicchetti, & J. R. Weisz (Eds.), *Developmental psychopathology: Perspectives on adjustment, risk and disorder* (pp. 139–165). New York: Cambridge University Press.
- Burack, J. A., Evans, D. W., Klaiman, C., & Iarocci, G. (2001). The mysterious myth of attention deficit and other defect stories: Contemporary issues in the developmental approach to mental retardation. *International Review of Research in Mental Retardation*, 24, 299–320.
- Burack, J. A., Hodapp, R. M., & Zigler, E. (1988). Issues in the classification of mental retardation: Differentiating among organic etiologies. *Journal of Child Psychology and Psychiatry*, 29, 765–779.
- Burack, J. A., Hodapp, R. M., & Zigler, E. (Eds.). (1998). *Handbook of mental retardation and development*. New York: Cambridge University Press.
- Cicchetti, D. (1984). The emergence of developmental psychopathology. *Child Development*, 55, 1–7.
- Cicchetti, D. (1990). An historical perspective on the discipline of developmental psychopathology. In J. Rolf, A. S. Masten, D. Cicchetti, K. H. Nuechterlein, & S. Weintraub (Eds.), *Risk and protective factors in the development of psychopathology* (pp. 2–28). New York: Cambridge University Press.
- Cicchetti, D., & Beeghly, M. (Eds.). (1990). *Children with Down syndrome: A developmental perspective*. New York: Cambridge University Press.
- Cicchetti, D., & Cohen, D. J. (1995). Perspectives on developmental psychopathology. In D. Cicchetti & D. J. Cohen (Eds.), *Developmental psychopathology: Vol. 1. Theory and method* (pp. 3–20). New York: Wiley.
- Cicchetti, D., & Pogge-Hesse, P. (1982). Possible contributions of the study of organically retarded persons to developmental theory. In E. Zigler & D. Balla (Eds.), *Mental retardation: The developmental-difference controversy* (pp. 277–318). Hillsdale, NJ: Erlbaum.
- Dahlgren, S. O., & Trillingsgaard, A. (1996). Theory of mind in non-retarded children with autism and Asperger's syndrome: A research note. *Journal of Child Psychology and Psychiatry*, 37, 759–763.
- DiLavore, P. C., Lord, C., & Rutter, M. (1995). The pre-linguistic autism diagnostic observation schedule. *Journal of Autism and Developmental Disorders*, 25, 355–379.
- Dunn, L., & Dunn, L. (1997). *Peabody Picture Vocabulary Test* (3rd ed.). Circle Pines, MN: American Guidance Service.
- Dunn, L., Dunn, L., Whetton, C., & Pintillie, D. (1982). *British Picture Vocabulary Scale*. Slough, UK: NFER-Nelson Publishing.
- Dykens, E. M., & Hodapp, R. M. (2001). Research in mental retardation: Toward an etiologic approach. *Journal of Child Psychology and Psychiatry*, 42, 49–71.
- Dykens, E. M., Hodapp, R. M., & Finucane, B. M. (2000). *Genetics and mental retardation syndromes*. Baltimore, MD: Paul H. Brookes.
- Enns, J. T., & Burack, J. A. (1997). Attention and developmental psychopathology: The merging of disciplines. In J. A. Burack & J. T. Enns (Eds.), *Attention, development, and psychopathology* (pp. 3–28). New York: Guilford Press.
- Evans, D., Hodapp, R. M., & Zigler, E. (1995). Mental and chronological age as predictors of age-appropriate leisure activity in children with mental retardation. *Mental Retardation*, 33, 120–127.
- Frye, D., Zelazo, P. D., & Burack, J. A. (1999). Cognitive complexity and control: Implications for theory of mind in typical and atypical populations. *Current Directions in Psychological Science*, 7, 116–121.
- Hobson, P. (1991). Methodologic issues for experiments

- on autistic individuals' perception and understanding of emotion. *Journal of Child Psychology and Psychiatry*, 32, 1135–1158.
- Hodapp, R. M., & Burack, J. A. (1990). What mental retardation teaches us about typical development: The examples of sequences, rates, and cross-domain relations. *Development and Psychopathology*, 2, 213–225.
- Hodapp, R. M., Burack, J. A., & Zigler, E. (1990). The developmental perspective in the field of mental retardation. In R. M. Hodapp, J. A. Burack, & E. Zigler (Eds.), *Issues in the developmental approach to mental retardation* (pp. 3–26). New York: Cambridge University Press.
- Hodapp, R. M., & Zigler, E. (1995). Past, present, and future issues in the developmental approach to mental retardation and developmental disabilities. In D. Cicchetti & D. J. Cohen (Eds.), *Developmental psychopathology: Vol. 2. Risk, disorder, and adaptation* (pp. 299–331). New York: Wiley.
- Iarocci, G., & Burack, J. A. (1998). Understanding the development of persons with mental retardation: Challenging the myths. In J. A. Burack, R. M. Hodapp, & E. Zigler (Eds.), *Handbook of mental retardation and development* (pp. 349–381). New York: Cambridge University Press.
- Klin, A., & Volkmar, F. R. (1997). The pervasive developmental disorders: Nosology and profiles of development. In S. S. Luthar, J. A. Burack, D. Cicchetti, & J. R. Weisz (Eds.), *Developmental psychopathology: Perspectives on adjustment, risk and disorder* (pp. 208–226). New York: Cambridge University Press.
- Landa, R. (2000). Social language use in Asperger syndrome and high-functioning autism. In A. Klin, F. R. Volkmar, & S. S. Sparrow (Eds.), *Asperger syndrome* (pp. 125–155). New York: Guilford Press.
- Leekam, S. R., Hunnisett, E., & Moore, C. (1998). Targets and cues: Gaze-following in children with autism. *Journal of Child Psychology and Psychiatry*, 39, 951–962.
- Leekam, S. R., Lopez, B., & Moore, C. (2000). Attention and joint attention in preschool children with autism. *Developmental Psychology*, 36, 261–273.
- Leekam, S. R., & Moore, C. (2001). The development of attention and joint attention in children with autism. In J. A. Burack, T. Charman, N. Yirmiya, & P. R. Zelazo (Eds.), *The development of autism: Perspectives from theory and research* (pp. 105–129). Mahwah, NJ: Erlbaum.
- Loveland, K., & Tunali-Kotoski, B. (1998). Development of adaptive behavior in persons with mental retardation. In J. A. Burack, R. M. Hodapp, & E. Zigler (Eds.), *Handbook of mental retardation and development* (pp. 521–541). New York: Cambridge University Press.
- Luthar, S. S., Burack, J. A., Cicchetti, D., & Weisz, J. R. (Eds.). (1997). *Developmental psychopathology: Perspectives on adjustment, risk, and disorder*. New York: Cambridge University Press.
- Mawhood, L., Howlin, P., & Rutter, M. (2000). Autism and developmental receptive language disorder—A comparative follow-up in early adult life. I: Cognitive and language outcomes. *Journal of Child Psychology and Psychiatry*, 41, 547–559.
- McConachie, H. R., & Moore, V. (1994). Early expressive language of severely visually impaired children. *Developmental Medicine and Child Neurology*, 36, 230–240.
- Mercier, C., Mottron, L., & Belleville, S. (2000). A psychosocial study on restricted interests in high functioning persons with pervasive developmental disorders. *Autism*, 4, 406–425.
- Mervis, C., & Robinson, B. F. (1999). Methodological issues in cross-syndrome comparisons: Matching procedures, sensitivity, and specificity. *Monographs of the Society for Research in Child Development*, 64, 115–130.
- Mottron, L., Belleville, S., & Ménard, E. (1999). Local bias in autistic subjects as evidenced by graphic tasks: Perceptual hierarchization or working memory deficit? *Journal of Child Psychology and Psychiatry*, 40, 743–755.
- Mottron, L., & Burack, J. A. (2001). Enhanced perceptual functioning in the development of autism. In J. A. Burack, T. Charman, N. Yirmiya, & P. R. Zelazo (Eds.), *The development of autism: Perspectives from theory and research*. Mahwah, NJ: Erlbaum.
- Mottron, L., Limoges, E., & Jelenic, P. (in press). Can a cognitive deficit elicit an exceptional ability? The case of Nadia. In C. Wallesch, Y. Joannette, & A. R. Lecours (Eds.), *Classic cases in neuropsychology* (Vol. 2). Hove, UK: Psychology Press.
- Mundy, P. (1995). Joint attention and social-emotional approach behavior in children with autism. *Development and Psychopathology*, 7, 63–82.
- Mundy, P., Sigman, M., & Kasari, C. (1994). Joint attention, developmental level, and symptom presentation in autism. *Development and Psychopathology*, 6, 389–401.
- O'Riordan, M. (2000). Superior modulation of activation levels of stimulus representations does not underlie superior discrimination in autism. *Cognition*, 77, 81–96.
- O'Riordan, M., Plaisted, K., Baron-Cohen, S., & Driver, J. (2001). Superior target detection in autism. *Journal of Experimental Psychology: Human Perception and Performance*, 27, 719–730.
- Ozonoff, S., Pennington, B. F., & Rogers, S. J. (1990). Are there emotion perception deficits in young autistic children? *Journal of Child Psychology and Psychiatry*, 31, 343–361.
- Pennington, B. F., & Ozonoff, S. (1996). Executive functions and developmental psychopathology. *Journal of Child Psychology and Psychiatry*, 37, 51–87.
- Peterson, D. M., & Bowler, D. M. (2000). Counterfactual reasoning and false belief understanding in children with autism. *Autism*, 4, 391–405.
- Piven, J., Harper, J., Palmer, P., & Arndt, S. (1996). Course of behavioral change in autism: A retrospective study of high-IQ adolescents and adults. *Journal of the American Academy of Child and Adolescent Psychiatry*, 35, 523–529.
- Plaisted, K., O'Riordan, M., & Baron-Cohen, S. (1998a). Enhanced discrimination of novel, highly similar stimuli by adults with autism during a perceptual learning task. *Journal of Child Psychology and Psychiatry*, 39, 765–775.
- Plaisted, K., O'Riordan, M., & Baron-Cohen, S. (1998b). Enhanced visual search for a conjunctive target in autism: A research note. *Journal of Child Psychology and Psychiatry*, 39, 777–783.
- Prior, M. R. (1979). Cognitive abilities and disabilities in infantile autism: A review. *Journal of Abnormal Child Psychology*, 7, 357–380.
- Reilly, J., Klima, E. S., & Bellugi, U. (1990). Once more with feeling: Affect and language in atypical popula-

- tions. *Development and Psychopathology*, 2, 367–392.
- Rutter, M., & Sroufe, L. A. (2000). Developmental psychopathology: Concepts and challenges. *Development and Psychopathology*, 12, 265–296.
- Schultz, T. R., Gauthier, I., Klin, A., Fulbright, R. K., Anderson, A. W., Volkmar, R. R., Skudlarski, P., Lacadie, C., Cohen, D. J., & Gore, J. C. (2000). Abnormal versus temporal cortical activity among individuals with autism and Asperger syndrome during face discrimination. *Archives of General Psychiatry*, 57, 331–340.
- Shah, A., & Frith, U. (1993). Why do autistic individuals show superior performance on the block design task? *Journal of Child Psychology and Psychiatry*, 34, 1351–1364.
- Siegel, D. J., Minschew, N. J., & Goldstein, G. (1996). Wechsler IQ profiles in diagnosis of high-functioning autism. *Journal of Autism and Developmental Disorders*, 26, 389–406.
- Sigman, M. (1996). Behavioral research in childhood autism. In M. F. Lenzenweger & J. J. Haugaard (Eds.), *Frontiers of developmental psychopathology* (pp. 190–206). New York: Oxford University Press.
- Sigman, M., & Ruskin, E. (1999). Continuity and change in the social competence of children with autism, Down syndrome, and developmental delays. *Monographs of the Society for Research in Child Development*, 64.
- Sparrow, S., Marans, W., Klin, A., Carter, A., Volkmar, F. R., & Cohen, D. J. (1997). Developmentally based assessments. In D. J. Cohen & F. R. Volkmar (Eds.), *Handbook of autism and pervasive developmental disorders* (2nd ed., pp. 411–447). New York: Wiley.
- Sroufe, L. A., & Rutter, M. (1984). The domain of developmental psychopathology. *Child Development*, 55, 17–29.
- Tager-Flusberg, H. (Ed.). (1999). *Neurodevelopmental disorders*. Cambridge: MIT Press.
- Volkmar, F. R., Burack, J. A., & Cohen, D. J. (1990). Deviance and developmental approaches in the study of autism. In R. M. Hodapp, J. A. Burack, & E. Zigler (Eds.), *Issues in the developmental approach to mental retardation* (pp. 246–271). New York: Cambridge University Press.
- Volkmar, F. R., Klin, A., & Cohen, D. J. (1997). Diagnosis and classification of autism and related conditions: Consensus and issues. In D. J. Cohen & F. R. Volkmar (Eds.), *Handbook of autism and pervasive developmental disorders* (2nd ed., pp. 5–40). New York: Wiley.
- Wagner, S., Ganiban, J. M., & Cicchetti, D. (1990). Attention, memory and perception in infants with Down syndrome: A review and commentary. In D. Cicchetti & M. Beeghly (Eds.), *Children with Down syndrome: A developmental perspective* (pp. 147–179). New York: Cambridge University Press.
- Werner, H. (1957). The concept of development from a comparative and organismic point of view. In D. Harris (Ed.), *The concept of development* (pp. 125–148). Minneapolis, MN: University of Minnesota Press.
- Yirmiya, N., Erel, O., Shaked, M., & Solomonica-Levy, D. (1998). Meta-analyses comparing theory of mind abilities of individuals with autism, individuals with mental retardation, and normally developing individuals. *Psychological Bulletin*, 124, 283–307.
- Zelazo, P. D., Burack, J. A., Benedetto, E., & Frye, D. (1996). Theory of mind and rule use in individuals with Down syndrome: A test of the uniqueness and specificity claims. *Journal of Child Psychology and Psychiatry*, 37, 479–484.
- Zigler, E., & Glick, M. (1986). *A developmental approach to adult psychopathology*. New York: Wiley.
- Zigler, E., & Hodapp, R. M. (1986). *Understanding mental retardation*. New York: Cambridge University Press.
- Zilbovicius, M., Garreau, B., Samson, Y., Remy, P., Barthélémy, C., Syrota, A., & Lelord, G. (1995). Delayed maturation of the frontal cortex in childhood autism. *American Journal of Psychiatry*, 152, 248–252.
- Zimmerman, A. W., & Gordon, B. (2000). Neural mechanisms in autism. In P. J. Accardo, C. Magnusen, & A. J. Capute (Eds.), *Autism: Clinical and research issues* (pp. 1–24). Baltimore, MD: York Press.