

Associations between mental health problems and challenging behavior in adults with intellectual disabilities: A test of the behavioral equivalents hypothesis

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Title

Associations between mental health problems and challenging behavior in adults with intellectual disabilities: A test of the behavioral equivalents hypothesis.

Abstract**Introduction**

Current research findings in the field of intellectual disabilities (ID) regarding the relationship between mental health problems and challenging behavior are inconclusive and/or contradictory. The aim of this study was to further investigate the putative association between these two, highly prevalent phenomena, in people with ID and specifically to explore the hypothesis that challenging behaviors may be behavioral equivalents of mental health problems.

Methods

A sample of 160 adults accessing secondary care ID health services were assessed using five validated measures. These included ratings of severity of disability, mental health problems, Autism behaviors, physical health problems, and four different aspects of challenging behavior. In conjunction with demographic information, four multiple regression analyses were undertaken to examine the interaction between mental health problems (moderated by severity of disability) and ratings of overall challenging behavior, aggression, self-injurious behavior, and stereotypy. In each case; age, gender, Autism, and physical health problems were included as covariates.

Results

There was a statistically significant association between mental health problems and ratings of overall challenging behavior, as well as the moderating effect of severity of disability. Importantly, the positive association between mental health problems and challenging behavior was only significant at more severe levels of disability.

Conclusions

These findings support the 'behavioral equivalents' hypothesis for mental health problems and challenging behaviors. However, further longitudinal research is required before this hypothesis can be considered unequivocally supported.

Keywords

Mental health, challenging behavior, intellectual disabilities, behavioral equivalents, adults, psychopathology, ASD

Background

The prevalence of both challenging behaviors and mental health problems is high in people with intellectual disabilities (ID; Cooper, Smiley, Morrison, Williamson, & Allan, 2007; Hemmings, Deb, Chaplin, Hardy, & Mukherjee, 2013). These problems often co-exist (Pruijssers, van Meijel, Maaskant, Nijssen, & van Achterberg, 2014) and adversely affect the quality of life of individuals (Totsika, Felce, Kerr, & Hastings, 2010), families, and carers (Tsiouris, Kim, Brown, & Cohen, 2011). Despite the significance of the putative association between mental health problems and challenging behavior, our understanding of the relationship between them remains incomplete (Melville, Johnson, Smiley, Simpson, Purves, et al., 2016). As a result, a number of hypotheses regarding their relationship have been suggested. Emerson (2001), for example, proposes that challenging behaviors may be: behavioral equivalents (i.e. atypical presentations) of mental health problems; secondary features of mental health problems; or conversely, that mental health problems may serve to maintain pre-existing challenging behaviors.

Potential explanations for this uncertainty include: fundamental differences in diagnostic constructs for people with ID (Bertelli, Rossi, Scuticchio, & Bianco, 2015; Melville, Johnson, Smiley, Simpson, Purves, et al., 2016); inconsistent definitions of challenging behavior (Hemmings et al., 2013); overlap between the two problems (Holden & Gitlesen, 2009), and practical difficulties in utilising a categorical diagnostic system in both clinical practice and research (Thakker, Bamidele, Ali, & Hassiotis, 2012). Against this challenging backdrop, the research can, at best, be interpreted in different ways (Bernstein, Visconti, Csorba, Radvanyi, & Rojahn, 2015)

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3 and, at worst, as contradictory (Hemmings, Deb , Chaplin, Hardy, & Mukherjee,
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5 2013; McCarthy et al., 2010).
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8 In 2000, Moss's United Kingdom (UK) cross-sectional study of individuals with
9 ID established that the severity of challenging behavior increased with the number of
10 mental health problems, but that challenging behavior could not be used to make
11 psychiatric diagnoses. Later, Tsiouris, Mann, Patti, and Sturmey (2003) divided
12 adults with a wide range of severities of ID into those with and those without
13 depression. They deduced that the two groups differed significantly in terms of
14 depressive symptoms, but not challenging behavior and hence concluded that
15 mental health and challenging behavior were independent constructs. This finding
16 was challenged by Crocker, Mercier, Allaire, and Roy (2007) who found that low
17 levels of challenging behavior were strongly associated low levels of mental health
18 problems and vice versa. Similarly, Hurley (2008) found that, whilst challenging
19 behavior did not distinguish between different psychiatric diagnoses, it was a key
20 feature of depression in people with ID. Soon after, Felce, Kerr, and Hastings's
21 (2009) study also challenged that of Tsiouris et al. (2003), finding a significant
22 relationship between mental health problems and challenging behavior which was
23 more pronounced at lower levels of adaptive behavior. More fundamentally, Holden
24 and Gitlesen (2009) found significant overlap between carers' identification of
25 challenging behavior and psychiatric symptoms. Effectively questioning the reliability
26 of reporting, they drew no definitive conclusions, instead outlining a number of
27 potential hypotheses similar to those that had been previously described by Emerson
28 (2001). Next, McCarthy et al., (2010) , found that individuals with Autistic Spectrum
29 Disorders (ASD) and ID were significantly more likley to exhibit challenging behavior
30 than those with ID alone. They also concluded that a diagnosis of severe ID was
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3 associated with challenging behavior. In contrast to some earlier studies, McCarthy
4
5 et al., (2010) found mental health problems were not associated with challenging
6
7 behavior, concluding they were relatively independent constructs. Also in 2010,
8
9 Sturme, Laud, Cooper, Matson, and Fodstad concluded that challenging behaviors
10
11 should not be viewed as depressive equivalents. However, using a similar
12
13 methodology, Hayes, McGuire, O'Neill, Oliver, and Morrison (2011) established that
14
15 low mood was associated with higher frequency and severity of challenging
16
17 behavior, tentatively concluding that challenging behavior may be indicative of low
18
19 mood in some institutionalized individuals with ID. Despite considering a range of
20
21 mental health problems, Sappok et al. (2014) found no association with challenging
22
23 behavior, instead identifying the strongest predictors to be the presence of ASD,
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25 younger age and lower levels of emotional development. Finally, Melville, Johnson,
26
27 Smiley, Simpson, Purves, et al. (2016) deduced that challenging behavior could not
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29 be considered symptomatic of depression as the two issues fell into separate factors
30
31 derived from the Psychiatric Present State-Learning Disabilities Examination Scale.
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37 Over the last two decades therefore, either by considering individual aspects
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39 of challenging behavior, or challenging behavior as a single entity, mental health
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41 problems and challenging behavior have been shown to be: both independent and
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43 overlapping constructs; that challenging behaviors may be, atypical presentations
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45 (behavioral equivalents) and secondary symptoms of mental health problems; and
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47 that mental health problems exacerbate or cause challenging behavior. In this way,
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49 proponents of each of Emerson's (2001) seminal hypotheses regarding the
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51 association between challenging behavior and mental health problems can all cite at
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53 least some supporting evidence (Thakker et al., 2012).
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3 In addition to the fundamental conceptual challenges described earlier, and
4 these contradictory findings, research has also been hampered by methodological
5 limitations. These include small sample sizes (Melville, Johnson, Smiley, Simpson,
6 Purves, et al., 2016), cross-sectional designs (Totsika et al., 2010) and tautological
7 issues (e.g. eliciting the presentation of mental health problems in people with ID by
8 analysing the behaviors of a group of individuals selected on the basis of a
9 diagnosed mental health condition [Hayes et al., 2011]). Latterly, considerable
10 doubt has also been cast on the statistical approaches employed, including failure to
11 control for potential confounding variables, the use of tests and procedures unsuited
12 to categorical data, and a failure to validate (confirm) exploratory factor analyses
13 (Melville, Johnson, Smiley, Simpson, McConnachie, et al., 2016; Melville, Johnson,
14 Smiley, Simpson, Purves, et al., 2016). Addressing confounding variables is
15 important since several of these, including age, gender, degree of ID, ASD, physical
16 health problems, and stressful life events (according to Hemmings et al., 2013) also
17 have their own supporting evidence for associations with challenging behavior.
18 Finally, it is important to note that most of these studies explore associations rather
19 than directly testing the behavioral equivalents hypotheses.
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41 In light of these uncertainties, it may only be legitimate to claim that the
42 relationship between challenging behavior and mental health problems in people
43 with ID is complex, multi-faceted, and potentially bi-directional (Hemmings et al.,
44 2013; Pruijssers et al., 2014; Sappok et al., 2014; Thakker et al., 2012). Our
45 intention was therefore to take account of the methodological concerns raised whilst
46 adding to the inconclusive evidence base surrounding the associations between
47 challenging behavior and mental health problems in people with ID. Consequently,
48 after controlling for other variables identified from the literature, we sought to test the
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3 hypothesis that challenging behaviors were behavioral equivalents of mental health
4 problems. To do this, we aimed to establish whether there was a statistically
5 significant association between mental health problems and four different aspects of
6 challenging behavior by replicating part of the approach taken by Felce, Kerr and
7 Hastings (2009) as this also considered whether the challenging behavior - mental
8 health relationship was moderated by level of ID.
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20 Method

21 Participants

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27 One hundred and sixty adults accessing secondary care specialist ID health
28 services in the UK were rated using a range of validated measures. Eighty eight
29 (55.0%) of these individuals were male and their mean age was 38.6 years (range
30 18-71 years). Treatment setting information was available for 126 cases, of which 32
31 (25.4%) were currently admitted to specialist ID acute inpatient services. The
32 ethnicity of 154 individuals was recorded, 145 (94.2%) of whom were White British.
33 Accommodation status was available for 89 (72.4%) of the 123 individuals residing in
34 community (rather than inpatient settings). Of these, 16 (18.0%) were living
35 independently in mainstream housing whilst 24 (27.0%) were living with family or
36 friends. A further 46 (51.7%) were living in some form of supported accommodation
37 (i.e. placements with varying levels of paid staff input). By virtue of their acceptance
38 into ID services, clinicians deemed all individuals to have ID however, a formal
39 primary or secondary ID diagnosis had also been recorded for 119 (74.4%)
40 individuals. Of these, 50 (42.0%) were for mild ID, 52 (43.7%) moderate, 15 (12.6%)
41 severe and 2 (1.7%) profound. These individuals had been referred into ID health
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3 services for a variety of primary reasons. Of the 696 cases where this information
4 was available, the most frequent referral reasons were: challenging behavior
5 ($n=180$); mental health problems ($n=110$); general vulnerability ($n=67$); ASD ($n=62$);
6 mobility and posture ($n=55$), epilepsy ($n=34$); social emotional functioning issues
7 ($n=30$); communication problems ($n=26$); offending behavior ($n=24$), and support in
8 accessing mainstream primary care services ($n=23$).
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20 Measures

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22 In addition to the collection of routine demographic and other relevant clinical
23 information (see above), individuals were rated with five assessment tools, each
24 focusing on a domain (emboldened below) that had been identified as clinically
25 important by a large, multidisciplinary group of specialist ID professionals. Initially, a
26 list of candidate measures was identified via a brief literature review before selection
27 criteria were applied to provide a final choice. Given that (with the exception of the
28 clinician-rated mental health measure described below) informants would not receive
29 training, the primary criteria were brevity and simplicity; however, psychometric
30 quality and cost were also considered. The final selection was:
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- 44 • The Mental Health and Wellbeing (MHW) subscale of the Learning Disability
45 Needs Assessment Tool (LDNAT; Painter, Trevithick, Hastings, Ingham, & Roy,
46 2016) which was used as a clinician-rated measure of the overall **severity of**
47 **mental health problems**. The LDNAT is a brief (23 item) holistic needs
48 assessment developed from the Health of the Nation Outcomes Scales (HoNOS;
49 Wing, Curtis, & Beevor, 1996). The tool was validated using data from 1,692
50 adults with a broad range of presenting problems and levels of ID and
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3 demonstrated good internal consistency (Cronbach's alpha = 0.80) and excellent
4 test-retest reliability ($ICC = 0.91$). The Mental Health and Wellbeing subscale was
5 derived through principal component analysis and consists of 6 of these 0-4
6 scales including hallucinations/delusions, depressed mood, relationships, and
7 strong unreasonable beliefs, which are summed to give a total score out of 24.
8 For this sample, the internal consistency of the MHW subscale was acceptable
9 (Cronbach's alpha 0.72).

- 10 • The Waisman Activities of Daily Living Scale (WADL; Maenner et al., 2013) which
11 was employed as an assessment of **general ability/severity of disability**.

12 Raters record whether different activities of daily living can be performed
13 independently (scoring 2), with help (scoring 1), or not at all (scoring 0). The tool
14 includes 17 activities which range from basic skills (e.g. using a cup) to more
15 advanced tasks (e.g. budgeting) and was originally validated on people with a
16 broad range of ID diagnoses. For our sample, the WADL's internal consistency
17 was excellent (Cronbach's alpha = 0.94).

- 18 • The Behavior Problems Inventory for Individuals with Intellectual Disabilities-
19 Short Form (BPI-S; Mascitelli et al., 2015; Rojahn et al., 2012a, 2012b) was used
20 to rate **challenging behaviors**. This shortened (30-item) version was developed
21 from the original 52-item version. It captures a range of self-injurious behaviors
22 (e.g. head-hitting), aggressive or destructive behaviors (e.g. verbal aggression)
23 and stereotyped behaviors (e.g. rocking or repetitive body movements). The
24 frequency rating for each scale was used to provide an overall challenging
25 behavior total score and three subscale scores (aggression, self-injurious
26 behavior and stereotypy). For our sample of 160 cases, internal consistency for
27 the total BPI-S was good (Cronbach's alpha = .89), whilst for the aggression, self-
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3 injurious behavior, and stereotypy subscales Cronbach's alphas were: .83, .50,
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5 and .76 respectively.
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8 • The Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003)
9
10 rated the **severity of ASD symptoms**. The SCQ has been validated with all age
11
12 groups (Brooks & Benson 2013) and has 40 'yes/no' questions covering the
13
14 primary features of ASD. For example: 'Does he/she have interests that pre-
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16 occupy him/her and might seem odd to other people (e.g. traffic lights, drainpipes
17
18 or timetables)?' As the SCQ responses are dichotomous, analysis of internal
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20 consistency was undertaken using the Kuder-Richardson formula (Grove &
21
22 Ciper, 2017). For our sample internal consistency was good (Kuder-Richardson
23
24 alpha = 0.85).
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28 • In the absence of a suitable physical health questionnaire, we created a bespoke
29
30 tool, based on the POMONA study (Haverman et al., 2011) which was a large
31
32 European study of the health status of people with ID. This comprised 12 yes/no
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34 questions (e.g. 'Is the person blind/visually impaired?'), three scaled questions
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36 (e.g. 'How good is the person's health in general?: Very good/ good/ fair/ bad/
37
38 very bad/ don't know'), as well as recordings of height and weight. The first 15
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40 questions were summed to provide an indication of the overall **level of physical**
41
42 **health and disability**. This tool has not yet been fully validated; however, a brief
43
44 investigation of its internal consistency yielded acceptable results in the larger
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46 ($n=1692$) study (Cronbach's alpha = 0.73) and similar results for this sample
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48 (Cronbach's alpha = 0.72).
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Procedure

The data analysed in this study were drawn from a larger dataset collected as part of a broader UK project (see Painter et al., 2016) . Briefly however, participating National Health Service (NHS) ID healthcare providers sourced the required demographic and clinical data from their routinely recorded patient information systems before submission via a standardized, encrypted dataset to the research team for collation and central analysis.

Between July 2014 and August 2015, three NHS trusts involved in the wider study were also able to consider the nature of the individuals with ID in receipt of their services in more detail. Following delivery of standardized training package in the use of the LDNAT, for each referral to their service, these NHS providers' health professionals rated the individual with ID as part of their routine assessment process. In contrast, these clinicians were then asked by the authors to identify a different person who knew the individual with ID well enough to independently complete the four other measures described above. Typically these informants were General Practitioners, family members or carers. They were subsequently telephoned by the research team and asked to complete the battery of assessment tools. Those that agreed were sent the four questionnaires for completion within two weeks. Once returned to the research team, these ratings were added to the electronic clinical data that had been submitted by the three services for analysis. This naturalistic study of routinely collected clinical data received governance approval for the purposes of NHS service evaluation.

Statistical analysis

All data for the 160 individuals' case records were entered into SPSS version 24. Correlation coefficients were calculated to identify any associations between the variables identified in the literature and participants' mental health and well-being. Data were also checked for multi-collinearity, a lack of autocorrelation and other regression assumptions before a number of moderated multiple linear regression analyses were performed using Hayes' (2013) PROCESS software and method. PROCESS allows independent and dependent variables to be entered as well as multiple co-variates. Importantly, it also allows variables to be entered as moderators so that their interaction with the independent variable can be understood, as well as their direct effect on the dependent variable. In addition to ease of use, after centering the variables, another advantage of the PROCESS macro is its use of bootstrapping (multiple resampling) to estimate confidence intervals for the effect of the moderator at a number of values (Hayes, Montoya, & Rockwood, 2017).

Based on findings from Felce et al. (2009), we examined whether the association between mental health problems and challenging behavior may have been affected (moderated) by severity of ID. This enabled a direct test of the behavioral equivalents hypothesis. The relationship between the LDNAT's MHW subscale scores (modelled as the independent variable) and the total BPI-S score (as the dependent variable) was explored using the total WADL scores as the moderator, whilst also controlling for age, gender, total SCQ score, and total physical health score. To estimate the moderating effect of the WADL the PROCESS bootstrapping functionality was set at 5000 resamples. This provided estimates at the mean as well as 1SD above and below it. The conceptual model for this regression is depicted in Figure 1.

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3 **Insert Figure 1 here**
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6 This analysis was subsequently repeated with the total BPI-S score being
7 replaced for each subscale total in turn (i.e., separate models for self-injury,
8 aggression, and stereotypy).
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12 13 14 15 16 17 **Results** 18

19 From the preliminary exploration of the data, correlational analyses (Table 1)
20 revealed that, of the covariates, only age was significantly associated with the Mental
21 Health and Wellbeing subscale of the LDNAT ($r = -.31, p < .01$). However, all putative
22 predictor variables were retained in the multiple regression analyses due to their
23 presence and reported clinical significance in the existing research literature. The
24 standard assumptions for linear regressions were met with, for example, multi-
25 collinearity tolerances ranging from 0.53-1.00, variance inflation factors (VIFs) all
26 below 1.90 (c.f. Grove & Ciper, 2017, p335), residuals relatively normally
27 distributed, and Durbin-Watson test results ranging from 1.83-2.44 which confirmed
28 the independence of these residuals (c.f. Field, 2009, p220).
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45 The results of the analysis of total BPI-S scores can be seen in table 2. Here
46 25.6% of variation in overall challenging behavior was explained by the regression
47 model ($F [7, 139] = 6.850; p < 0.001$). The MHW subscale (measuring severity of
48 mental health problems) and the total SCQ co-variate (measuring severity of ASD)
49 were significantly positively associated with the total BPI-S score indicating that
50 those with more mental health problems or ASD symptoms were more likely to also
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3 exhibit challenging behavior. The WADL (measuring level of impairment) was
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5 negatively correlated with this overall measure of challenging behavior; however, it is
6
7 important to note that higher WADL scores indicate less impairment and thus
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9 individuals with more severe impairment were also more likely to exhibit challenging
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11 behavior. Finally, the interaction term between the MHW subscale and the WADL
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13 was a significant predictor of the BPI-S total score. Further analysis using Hayes's
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15 (2013) PROCESS software established that the conditional effect of the MHW
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17 subscale on total BPI-S was significant at lower, i.e. 1SD below the mean ($b=1.2066$,
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19 $95\%CI [.295, 2.110]$), but not at mean ($b=.439$, $95\%CI [-.274, 1.150]$) or higher, i.e.
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21 1SD above the mean ($b=-.329$, $95\%CI [-1.396, .73]$) WADL scores. Thus, the
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23 association between mental health and challenging behavior was strongest at more
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25 severe levels of ID.
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33 The results of the analysis of BPI-S aggressive/destructive behavior scores
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35 can be seen in table 3. Here 15.3% of variation in aggressive behaviors was
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37 explained by the regression model ($F [7,139] = 3.590$; $p<0.001$). In this case, only
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39 the MHW subscale (measuring severity of mental health problems) had a statistically
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41 significant positive association with the BPI-S aggression subscale score. This
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43 suggests that individuals with more severe mental health problems also exhibit
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45 higher levels of aggression.
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52 The results of the analysis of BPI-S self-injurious behavior scores can be seen
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54 in table 4. Here 23.9% of the variation in self-injurious behaviors was explained by
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56 the regression model ($F [7,137] = 6.155$; $p<0.001$). Again the MHW subscale
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3 (measuring severity of mental health problems) was significantly positively
4 associated with the aspect of challenging behavior measured. In contrast, the
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6 interaction between the MHW subscale and the WADL (but not the main effect of the
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8 WADL itself) was negatively correlated with self-injurious behavior. As with the first
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10 analysis, the PROCESS macro for SPSS was used to establish that the conditional
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12 effect of the MHW subscale on the BPI-S self-injurious behavior subscale was only
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14 significant at lower, i.e. 1SD below the mean ($b=.297$, 95%CI [.090, .500]) but not at
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16 mean ($b=.051$, 95%CI [-.111, .210]) or higher, i.e. 1SD above the mean ($b=-.196$,
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18 95%CI [-.438, .040]) WADL scores. Thus the association between mental health
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20 and challenging behavior was strongest at more severe levels of ID.
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32 The results of the final analysis (of BPI-S stereotypy scores) can be seen in
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34 table 5. Here 19.3% of the variation in stereotyped behaviors was explained by the
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36 regression model ($F [7, 138] = 4.703$; $p < 0.001$). The WADL (measuring impairment)
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38 had a significant negative association with this aspect of challenging behavior whilst
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40 the total SCQ co-variable (measuring severity of ASD) was positively associated with
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42 the BPI-S stereotypy subscale score. This indicates that individuals who were more
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44 severely impaired were more likely to exhibit stereotyped behaviors, as were
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46 individuals with more severe ASD.
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Discussion

From a brief review of the literature it is clear that research into the interaction between mental health problems and challenging behavior in people with ID has yielded contradictory findings and has often been limited to the identification of main effect associations only, and hence that the relationship remains poorly understood. Consequently, the broad aim of our study was, to investigate the relationship between mental health problems (as measured by the MHW subscale of the LDNAT) and challenging behavior (as measured by different elements of the BPI-S) when moderated by severity of disability (measure by the WADL), meaning that, unlike most previous studies, our analysis approach directly tested the behavioral equivalents hypothesis. In doing so, we also set out to control for age, gender, severity of ASD, and physical health problems. None of our moderated multiple regression models explained more than a quarter of the variation in the aspect of challenging behavior analysed, suggesting that other (unmeasured) variables were also having a significant impact. This is unsurprising, given the highly complex and multi-faceted nature of the functions and topography of challenging behavior and the range of correlates for challenging behavior in previous research (Bowring, Totsika, Hastings, Toogood, & Griffith, 2017; Hemmings et al., 2013; Pruijssers et al., 2014; Sappok et al., 2014).

Our main findings were that clinician-rated mental health problems had a significant positive association with the overall measure of challenging behavior, as well as the aggression and the self-injurious behavior (but not the stereotypy) subscales. In our sample, therefore, people who presented with more severe mental

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3 health problems also exhibited more challenging behaviors. This supports previous
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5 studies by Felce et al. (2009); Hayes et al. (2011); Hurley (2008) and Moss (2000)
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7 but is in contrast to results from McCarthy et al. (2010); Melville, Johnson, Smiley,
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9 Simpson, Purves, et al. (2016); Sappok et al. (2014); Sturmey et al. (2010) and
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11 Tsiouris et al. (2003).
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15 The interaction between mental health problems and level of impairment
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17 (WADL scores) was significant in the analyses of overall challenging behavior and
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19 self-injurious behavior. Further analyses showed that the association between
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21 mental health problems and overall challenging behavior and self-injurious behavior
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23 was only significant at lower levels of ability (i.e., in those with more severe ID).
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25 These results support the 'behavioral equivalents hypothesis' also supported in
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27 analyses by Felce et al. (2009); Hayes et al. (2011) and Hurley (2008) but refuted by
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29 McCarthy et al. (2010); Melville, Johnson, Smiley, Simpson, Purves, et al. (2016);
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31 Sappok et al. (2014); and Sturmey et al. (2010).
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36 We also found the severity of ASD to be independently significantly positively
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38 associated with overall challenging behavior and the stereotypy subscale suggesting
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40 that people with more severe ASD exhibit more stereotyped behaviors and
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42 challenging behavior overall. We also found that these two aspects of challenging
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44 behavior were significantly independently associated with severity of disability.
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46 These associations between ASD and severity of ID with challenging behavior have
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48 also been found in other research (e.g., McCarthy et al., 2010; Sappok et al., 2014).
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50 Finally, we found no statistically significant independent associations between any of
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52 our four ratings of challenging behavior and either age, gender, or physical health
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54 problems despite all having been found to have a relationship with challenging
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56 behavior in other previous research (Hemmings et al., 2013).
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3 Our study addressed a number of the methodological weaknesses (described
4 earlier) raised by Hayes et al. (2011); Melville, Johnson, Smiley, Simpson,
5 McConnell, et al. (2016); Melville, Johnson, Smiley, Simpson, Purves, et al.
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10 (2016); and Totsika et al. (2010). However, despite these strengths, as with most
11 naturalistic studies, our research has a number of limitations which it is important to
12 recognize. For example, although (according to Green's [1991] rules of thumb) the
13 sample size is sufficient for a multiple regression, it remains modest. It also included
14 a higher proportion of more able participants. Additionally the study design (as for all
15 others cited here) is cross-sectional, precluding cause and effect from being
16 definitively concluded. The internal consistency of the BPI-S self-injurious behavior
17 sub-scale was also low, and so the findings focused on self-injury do need to be
18 treated with caution and replicated. Finally, there will inevitably also be variation in
19 data quality arising from the cascade training model used for data collection.
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32 Overall however, we believe our study adds to the existing evidence base
33 regarding the 'behavioral equivalents' hypothesis by specifically incorporating the
34 moderating effect of the severity of disability on mental health problems when
35 analysing their interaction with three different aspects of challenging behavior
36 (aggression, self-injurious behaviors and stereotypy) as well as an overall rating of
37 challenging behavior. The findings also have clinical significance in that they clearly
38 suggest that individuals with more severe ID who exhibit challenging behavior should
39 be carefully screened to eliminate explanations related to treatable mental health
40 problems before undertaking other, more complex/costly assessment and
41 intervention. In addition, where behavioral intervention is undertaken to address
42 challenging behavior, practitioners should monitor for ongoing or emerging mental
43 health problems. Where ongoing and treatment resistant mental health problems are
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3 detected, practitioners should also undertake structured assessment of the
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5 interaction between mental health and challenging behavior (e.g., where the
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7 presence of hallucinations/delusions may heighten distress and exacerbate displays
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9 of aggression directed towards others). This may help to develop a broader case
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11 formulation and shape specific interventions that target the exacerbation and
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13 maintenance of challenging behavior.
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17 In terms of future research, larger-scale studies are now required which take
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19 account of the highlighted weaknesses in previous studies' designs and, in particular,
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21 adopt a longitudinal approach to resolve the current ambiguous and contradictory
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23 research findings.
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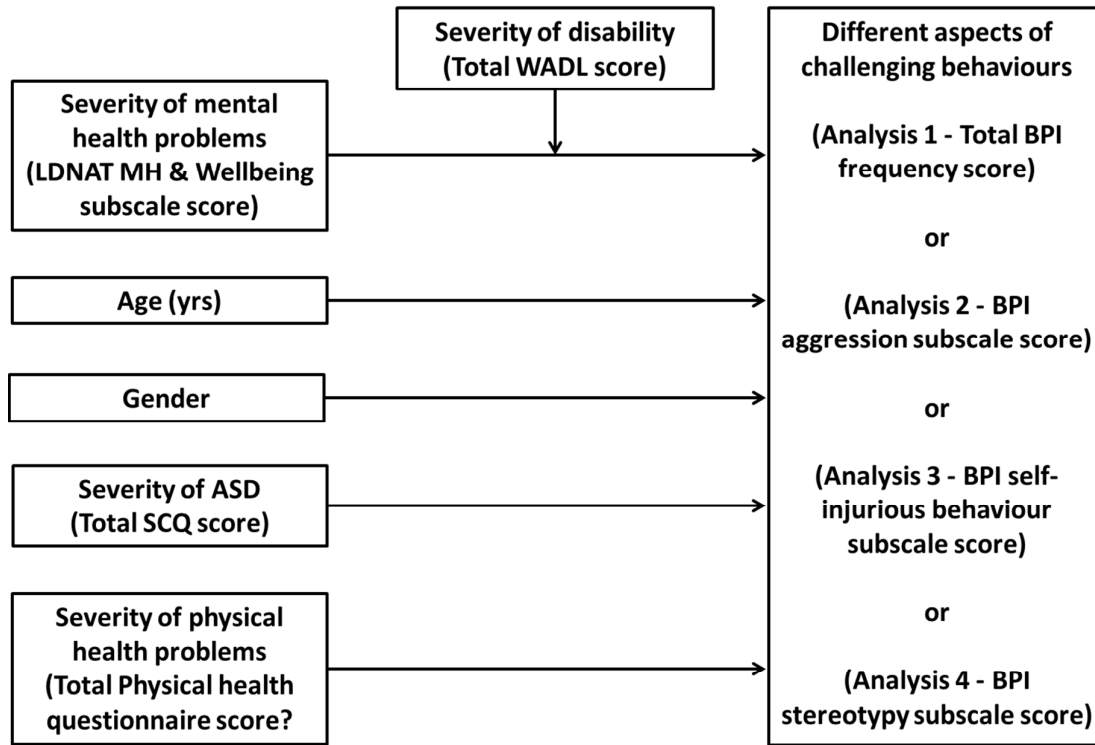
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Figure 1: Conceptual diagram of Hayes (2013) moderated multiple regression model as applied to the current research



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Table 1: Correlations between the LDNAT's Mental Health and Wellbeing subscale and each predictor used in regression analyses

		Total Physical Health Score	Age	Gender	Total WADL score	Total SCQ score	Total BPI-S score	Total BPIS-Stereotypy subscale score	Total BPIS-Aggression subscale score	Total BPIS-Self-injurious Behavior subscale score
LDNAT Mental Health and Wellbeing subscale	Pearson Correlation	-0.052	-.308*	0.009	-0.029	-0.102	.169	0.072	.278**	0.120
	Sig. (2-tailed)	0.512	0.000	0.908	0.713	0.211	0.036	0.378	0.001	0.142
	N	160	160	160	159	153	153	152	153	151

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table 2: Moderated multiple regression model for total BPI-S score

Variable	Beta [95% CIs]	p
Age	-.142 [-.348, .064]	.176
Gender	1.312 [-4.333, 6.956]	.647
Total Physical Health score	-.341 [-1.722, 1.039]	.626
Total SCQ score	.661 [.204, 1.118]	.005
Total WADL score	-.643 [-1.256, -.031]	.040
LDNAT MH and Wellbeing subscale score	2.177 [.563, 3.791]	.009
Interaction (WADL X MHW subscale)	-.095 [-.181, -.010]	.030

N.B. $R^2 = .256$, $F(7, 139) = 6.850$; $p < 0.001$

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Table 3: Moderated multiple regression model for BPI-S Aggression subscale score

Variable	Beta [95% CIs]	p
Age	-.038 [-.109, .034]	.299
Gender	.755 [-1.204, 2.713]	.448
Total Physical Health score	.096 [-.383, .575]	.693
Total SCQ score	.135 [-.023, .294]	.094
Total WADL score	-.101 [-.314, .112]	.349
LDNAT MH and Wellbeing subscale score	.633 [.073, 1.193]	.027
Interaction (WADL X MHW subscale)	-.016 [-.046, .014]	.290

N.B. $R^2 = .153$, $F(7, 139) = 3.590$; ($p=0.001$)

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Table 4: Moderated multiple regression model for BPI-S self-injurious behavior subscale score

Variable	Beta [95% CIs]	p
Age	-.029 [-.076, .018]	.226
Gender	.212 [-1.073, 1.498]	.745
Total Physical Health score	.045 [-.266, .357]	.775
Total SCQ score	.077 [-.027, .180]	.144
Total WADL score	-.067 [-.205, .072]	.344
LDNAT MH and Wellbeing subscale score	.605 [.241, .969]	.001
Interaction (WADL X MHW subscale)	-.031 [-.050, -.011]	.002

N.B. $R^2 = .239$, $F(7, 137) = 6.155$; ($p < 0.001$)

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Table 5: Moderated multiple regression model for BPI-S stereotypy subscale score

Variable	Beta [95% CIs]	p
Age	-.081 [-.226, .065]	.275
Gender	.295 [-3.660, 4.250]	.883
Total Physical Health score	-.480 [-1.445, .486]	.328
Total SCQ score	.445 [.125, .765]	.007
Total WADL score	-.460 [-.891, -.030]	.036
LDNAT MH and Wellbeing subscale score	.943 [-.186, 2.072]	.101
Interaction (WADL X MHW subscale)	-.050 [-.110, .010]	.100

N.B. $R^2 = .193$, $F(7, 138) = 4.703$; ($p < 0.001$)

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