Neurofibromatosis type 1 (NF1) is a frequent autosomal dominant disorder affecting 1 in 3,000 individuals (Friedman, 1999; Lammert, Friedman, Kluwe, & Mautner, 2005). NF1 is primarily characterized by pigmentation abnormalities, benign tumor formation of the peripheral nervous system, and distinctive bony lesions. The disease is caused by mutations in the \( Nf1 \) gene (Viskochil et al., 1990). Diagnostic criteria for the disorder were established by the National Institutes of Health (NIH, 1988): six or more cafe au lait patches; two or more neurofibromas, or one plexiform neurofibroma; axillary or inguinal freckling; Lisch nodules; optic glioma; a first degree relative with NF1; and distinctive osseous (bone) lesion.

Cognitive difficulties are well documented in children with NF1. Specific or generalized learning disabilities and impairments in academic achievement have been found in up to 70% of children with NF1 (e.g., Brewer, Moore, & Hiscock, 1997; Hyman, Shores, & North, 2006). Typical for NF1 patients are a slightly lower IQ, but within normal range (Dilts et al., 1996; Ferner, Hughes, & Weinman, 1996); specific deficits in attention (Hyman, Shores, & North, 2005); executive functioning; and perceptual skills (Payne, Hyman, Shores, & North, 2011). The most commonly reported functional impairment in children with NF1, next to learning problems, is attention problems (inattentive behavior) with an incidence of 54% (Payne et al., 2011). In addition, studies have reported that 30% to 50% of children with NF1 fulfill the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1998) criteria of an ADHD (Barton & North, 2004; Hyman et al., 2005; Mautner, Kluwe, Thakker, & Leark, 2002; Payne et al., 2011). Cognitive profiles seem to persist into adulthood with a slight increase of full IQ scales (Hyman et al., 2003).

Impairment in cognitive ability explains emotional problems in children with NF1 (Huijbregts & de Sonneville, 2010). There is also evidence that children with NF1 experience more psychosocial problems, mainly due to cognitive deficits (Noli et al., 2007). Especially children with NF1 and comorbid ADHD present poor social functioning (impaired social skills and social competence, more social problems; Barton & North, 2004), and show more emotional (anxiety, depression, and anger) problems. The most commonly reported functional impairment in children with NF1, next to learning problems, is attention problems (inattentive behavior) with an incidence of 54% (Payne et al., 2011). In addition, studies have reported that 30% to 50% of children with NF1 fulfill the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1998) criteria of an ADHD (Barton & North, 2004; Hyman et al., 2005; Mautner, Kluwe, Thakker, & Leark, 2002; Payne et al., 2011). Cognitive profiles seem to persist into adulthood with a slight increase of full IQ scales (Hyman et al., 2003).

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In addition to cognitive difficulties, quality of life impairment has also been reported in children with NF1 (Graf, Landoldt, Capone Mori, & Boltshauser, 2006; Krab et al., 2008; Wolkenstein et al., 2009). Quality of life was found to be impacted by demographic variables, disease severity, behavioral problems (Krab et al., 2008), and learning disabilities (Wolkenstein et al., 2009) in children with NF1.

Quality of life issues have also been reported for adults with NF1. Studies have found that clinical complications and disease-associated appearance (skin manifestations and skeletal deformations) affect the overall quality of life (Page et al., 2006; Wolkenstein, Zeller, Revuz, Ecosse, & Leplège, 2001). Health-related quality of life domains, which are affected by clinical complications, assessed by the NF1 disease severity scale (Riccardi, 1982) are physical functioning, bodily pain, general health perception, and vitality. Disease-associated appearance, for example, high visibility of disease symptoms, had an effect on the domains emotion, physical symptoms, and functioning (Wolkenstein et al., 2001). A high disease visibility, but not the disease severity, was also associated with psychological morbidity (Wolkenstein, Zeller, Revuz, Ecosse, & Leplège, 2003).

ADHD symptoms and their negative effect on academic performance, social functioning, and quality of life have been thoroughly investigated in children with NF1. However, to our knowledge, there are no studies addressing the question whether ADHD persists into adult age in NF1 patients. In addition, there are no investigations on the psychological phenotype of ADHD in adults with NF1 and the interaction of ADHD symptoms on quality of life in these patients. This is the first study examining (a) the psychological phenotype in adult NF1 patients with ADHD and (b) the impact or effect of ADHD on the quality of life as expressed by life satisfaction and emotional functioning. We hypothesized that we would find similar personality characteristics in NF1 with ADHD adults and adults with ADHD only and that these differ from personality characteristics in adult NF1 patients without ADHD. We also expected to find a significantly lower life satisfaction in the ADHD groups, independent of NF1 status.

Method

Participants and Procedure

Three groups of German adults were consecutively recruited for this study over a period of 1 year, and each participant underwent the same test battery and examinations. Following approval from the ethics committee, NF1 patients were recruited from the neurofibromatosis clinic in Hamburg and consented to participate in the study. Adults with ADHD but no NF1 were consecutive referrals from an independent board certified neurologist. The ADHD participants were mainly privately insured patients. All participants were questioned for medical history of head injury, loss of consciousness, epilepsy, or other conditions that might mimic ADHD before they were asked to participate. Patients previously treated for attention problems were excluded. The responses and performances of each group were analyzed and compared with each other. All participants were tested with standardized German measures and German language test versions (see below).

NF1 Sample. NIH criteria for NF1 were applied to confirm the diagnosis in participating patients. Adults with NF1 were evaluated as part of routine NF1 medical examination, including full neurological examination, magnetic resonance imaging (MRI), and routine medical tests and medical history (data not reported in this study). Furthermore, potential participants with NF1 were asked whether they had previously been diagnosed with learning disabilities. NF1 patients with previously diagnosed learning disabilities and/or an IQ lower than 85 in the cognitive testing were excluded from this study.

NF1 disease severity was classified in all NF1 patients using a dichotomized Riccardi scale (Riccardi, 1982). A low disease severity indicates NF1 without significant compromise of health and a high disease severity a significantly compromised health. Participants classified with high disease severity in our sample displayed hypertension/cardiac defects, history of breast cancer, psoriasis, symptomatic spinal tumors, larger plexiform neurofibromas, and/or disfiguring neurofibromas (e.g., 500 and more neurofibromas).

NF1 no ADHD. A total of 26 adults with NF1 ($M_{\text{age}} = 39.5$ years and $SD_{\text{age}} = 13.3$ years; 14 males and 12 females) without a positive history of attention problems in childhood were included to participate. These participants did not meet the DSM-IV criteria of ADHD. Four participants (4/26) were classified with high disease severity.

NF1 with ADHD. A total of 22 adults with NF1 ($M_{\text{age}} = 39.1$ years and $SD_{\text{age}} = 11.2$ years; 14 males and 8 females) and a positive history of attention problems in childhood were evaluated by a board certified neurologist to confirm ADHD diagnosis using DSM-IV criteria. ADHD diagnosis was made independent of testing. Within this group, six participants (6/22) were classified with high disease severity.

Control Group—ADHD no NF1. The control group contained 27 adults without NF1 ($M_{\text{age}} = 42.0$ years and $SD_{\text{age}} = 12.1$ years; 17 males and 10 females) with a positive history of attention problems in childhood. Diagnosis of ADHD was confirmed by a board certified neurologist using DSM-IV criteria and diagnosed independently of testing. Each participant received full neurological examination, routine medical tests, and medical history anamnesis (data not reported in this study).
Measures

**Cognitive functioning.** Participants’ cognitive functioning was assessed with the German standardized version of Wechsler Adult Intelligence Scale–Revised (WAIS-R) and Hamburg-Wechsler–Intelligence Test for adults (HAWIE-R; Tewes, 1994). The three main scales—full scale IQ (FSIQ), verbal IQ (VIQ), and performance IQ (PIQ)—were used in the study.

**Measures for adult ADHD symptoms and attention performance.** To assess symptoms indicative for adult ADHD, each participant filled in the German language version of the Wender Utah Rating Scale–long version (WURS) with 61 items (Groß, Blocher, Troll, & Rösler, 1999; Ward, Wender, & Reimherr, 1993) and the Brown Attention Deficit Disorder Scale–long version (BADDS) with 40 Items (Brown, 1996). WURS assesses ADHD symptoms that were presented in childhood. The participants were instructed to rate items of their own childhood behavior on a scale from 0 (mildly) to 4 (very much). High raw scores are indicative of someone who endorses items found to be predictive of ADHD found later in adulthood. The BADDS is a self-report measure of symptoms often found in adult ADHD samples. High raw scores are indicative of someone with adult ADHD symptoms. To assess attention performance and impulse control, each participant performed the Test of Variables of Attention (TOVA; Leark, Greenberg, Dupuy, Kindschi, & Corman, 1996). The TOVA is a 22.6-min long, computer-based continuous performance test consisting of a nonalphanumeric target and nontarget stimuli for which the participant presses a micro switch as quickly as possible after viewing the target stimuli. There are four major test measures: omission (missing the target), commission (misidentifying the nontarget as the target), response time (average in milliseconds), and response time variability (deviation of the response time in milliseconds). The test scores are summarized into four quarters, two halves, and a total score. We used the total score for each measure. Scores are standardized by gender and age.

**Measures of depression, life satisfaction, and personality traits.** Each participant filled in the same self-report measures on depression, life satisfaction (social functioning), and personality traits (personality and emotional functioning).

**Depression** was assessed with the German standardized version of the Beck Depression Inventory (BDI; Hautzinger, Bailer, Worall, & Keller, 1995). BDI is a 21-question inventory designed to assess how participants had been feeling during the last week. Each item is scaled from 0 to 3. Summarized total scores from 11 to 17 indicate mild and scores ≥18 clinically relevant depressive symptoms.

**Personality traits.** The Freiburg Personality Inventory–Revised (FPI-R; Fahrenberg, Hampel, & Selg, 1984) was administered to assess participants’ personality traits reflecting their personality and emotional functioning. The FPI-R is a multidimensional measure containing 10 personality trait scales and two dimensions of personality—extraversion/introversion and emotional stability/instability. The traits measured are as follows: life satisfaction, social orientation, performance orientation, inhibition, excitability, aggressiveness, tension/stress, somatic distress, health worries, and openness. A stanine scoring method is used. Higher scores represent higher expression of the items.

**Life satisfaction** was measured with The Life Satisfaction Questionnaire (FLZ; Fahrenberg, Myrtek, Schumacher, & Brähler, 2000). The FLZ contains 10 subscales measuring life satisfaction toward general health, career and trade, financial position, free time and leisure, marriage or partnership, relationship with own children, self-satisfaction, sexuality, family members/acquaintances and living situation, and an overall life satisfaction scale (summation of 7 subscales). A stanine scoring method is used with higher scores reflecting higher levels of life satisfaction.

Data Analysis

Clinical characteristics and demographics were described with frequency analysis and other descriptive methods. Gender frequency distribution data were analyzed by chi-square ($\chi^2$). Group differences in parametric data were analyzed with ANOVA and supplemented by effect-size determination ($\eta^2$). Effect sizes of 0.01, 0.059, and 0.138 represent small, medium, and large effects, respectively, in ANOVA (Cohen, 1988). Post hoc analyses were conducted between two group differences. Unpaired student tests were done to determine mean differences between the ADHD groups (ADHD without and with NF1) and NF1 no ADHD supplemented with effect-size determination (d), which was the mean difference divided through the averaged standard deviation. Effect sizes of 0.3, 0.5, and 0.8 represent weak, medium, and strong effects in unpaired student test, respectively (Cohen, 1988). Pearson correlations were conducted to determine the relationship between states of overall life satisfaction and personality traits. All statistical analyses were carried out using PASW Statistic 18.0 for Windows.

Results

**Sample Description**

In all three groups, we assessed partnership status, having own children, education, and working status. Given that some demographics showed unequal distribution across the three groups, a chi-square analysis was done to determine whether there were any possible distribution effects. There were significant group differences found in educational level indicating that the ADHD no NF1 group was higher educated (see Table 1, for demographics and sample descriptions). An ANOVA was conducted to determine whether there were mean age differences
between the groups. The ANOVA yielded nonsignificant differences between groups ($F = .65, df = 2, p = .65$). In addition, there were no between-group differences regarding NF1 disease severity ($\chi^2 = 1.02, df = 1, p < .31$).

**Cognitive Functioning**

ANOVA yielded significant differences for the three summary IQ measures across the three groups. On the FSIQ scale ($F = 26.8, df = 2, p < .001$), post hoc analysis found nonsignificant differences between the two NF1 groups but did find a significant difference between the NF1 groups and the ADHD no NF1 group. This was also found for the VIQ scale ($F = 15.9, df = 2, p < .000$) and the PIQ scale ($F = 23.7, df = 2, p < .000$). The NF1 groups had IQ scores within the normal range, but the ADHD no NF1 group did have an unexpectedly higher IQ score compared with the two other groups consistently across all IQ summary measures (Table 2).

**Adult ADHD Symptoms and Attention Performance**

As expected, significant group differences were found for the WURS ($F = 57.0, df = 2, p < .001$) and the BADDS ($F = 69.8, df = 2, p < .001$). Post hoc testing showed that the NF1 with ADHD and the ADHD no NF1 group had similarly elevated ratings on the ADHD measures confirming the diagnosis of the disorder. The two ADHD groups had significantly higher mean rating scores on both measures than the NF1 no ADHD group (see Table 2).

For the TOVA, ANOVA yielded significant differences between the three group means in reaction time variability ($F = 5.4, df = 2, p < .006, \eta^2 = .13$). Post hoc testing noted significant differences between the groups with ADHD compared with the NF1 no ADHD group. Although not statistically significant, small effect sizes were found for omission, commission, and reaction time suggesting that with a larger sample, significant differences are more likely to be found between the three groups (see Table 2).

TOVA scores, as well as those for the WURS and BADDS, reflect baseline performance as the ADHD participants were assessed prior to onset of any medication.

**Depression, Personality Traits, and Life Satisfaction**

Significant mean score differences were found between groups for depression (BDI; $F = 13.7, df = 2, p < .001, \eta^2 = .28$). Post hoc testing noted significant differences between the groups with ADHD (NF1 with ADHD, $M = 13.55, SD = 7.1$; ADHD no NF1, $M = 14.48, SD = 8.31$) compared with NF1 no ADHD group ($M = 5.16, SD = 3.99$). It is important to note that although there were statistically significant differences for the BDI, the total scores for the BDI were all within the normal range of performance based on the test’s normative data. Thus, although there were differences between groups, there was no clinical evidence, nor test evidence, for clinical depression.

On measures of personality functioning (FPI-R), group differences were found across 8 of the 12 scales (see Table 3). Post hoc analysis yielded differences between the two groups with ADHD compared with the NF1 no ADHD group over 6 of the 8 scales. Participants with ADHD described themselves with greater life dissatisfaction than did the NF1 no ADHD. They also described themselves as having greater levels of excitability, tension/stress, and somatic distress than did the NF1 no ADHD. The NF1 no ADHD had lower levels of aggressiveness than did the two ADHD groups. Participants with ADHD were significantly more emotionally instable than NF1 participants without ADHD.
On measures of life satisfaction (FLZ) between the three groups, mean score differences were found for 8 of the 11 scales (see Table 4). Both groups with ADHD (NF1 with ADHD and ADHD no NF1) had similar responses, as indicated by post hoc analysis, to the items on scales reflecting greater dissatisfaction toward oneself, relationships with family members and acquaintances, and overall life satisfaction than the NF1 no ADHD group. The NF1...
The ADHD group reported significantly greater dissatisfaction in general health and sexuality compared with the NF1 no ADHD group.

To make sure that the trait (FPI-R) and state (FLZ) measures assessed different aspects of functioning, we correlated the overall life satisfaction scale (FLZ) with the personality traits and dimensions (FPI-R). Pearson correlations yielded significant relationships between overall life satisfaction and five personality traits—life satisfaction ($r = .34$, $p < .01$), inhibition ($r = −.29$, $p < .05$), somatic distress ($r = −.33$, $p < .01$), openness ($r = −.23$, $p < .05$), and the personality dimension emotional instability/stability ($r = −.29$, $p < .05$).

### Discussion

In this study, we aimed to investigate the psychological and behavioral phenotype in adult NF1 patients diagnosed with ADHD and furthermore tested the impact of ADHD diagnosis on life satisfaction and emotional functioning in adults with NF1 and ADHD compared with those without ADHD symptoms. In this pilot study, we were able to show that adults with NF1 and ADHD display a similar psychological, emotional, and behavioral phenotype as adults with ADHD in the general population. Our findings indicate that ADHD symptoms are persistent in adults with NF1 and that these patients display typical ADHD associated problems. Second, we found that adults with NF1 and comorbid ADHD had significantly lower life satisfaction than NF1 participants without such symptoms. To test our hypotheses, we used standardized measures on emotional functioning (BDI and FPI-R) and life satisfaction (FLZ), and compared answers of the three groups: NF1 no ADHD, NF1 with ADHD, and the control group ADHD no NF1.

Our first interest was to determine whether NF1 adults with ADHD reported a similar psychological phenotype and emotional functioning as adults with ADHD only. As we expected, the NF1 with ADHD group scored similar to the ADHD no NF1 group, but significantly different from the NF1 no ADHD group on 6 of 12 personality traits. Participants with ADHD reported lower life satisfaction, more excitability, aggressiveness, tension/stress, more somatic distress, and more emotional instability than did the NF1 participants without ADHD. In the latter, all personality characteristics were within normal range with a tendency toward less social orientation, less aggressiveness, and more introversion than the normative sample. However, the personality traits in both ADHD groups were abnormal in comparison with norm values (see Table 3, values in boldface) on almost all scales. The personality traits found in our ADHD samples are in line with findings of previous research on adults with ADHD (Retz, Thome, Blocher, Baader, & Rösler, 2002; Retz-Junginger et al., 2003). Especially notable was our finding that participants with NF1 and ADHD appeared more emotionally instable than participants with ADHD alone, with the lowest emotional function in this NF1 subgroup. In the NF1 group without ADHD, the emotionality scale was within normal range.

Emotional stability is important for coping with chronic diseases, which means that adults with NF1 and attention problems are an at-risk group for psychological/psychiatric morbidity.

### Table 4. Group Differences in Satisfaction in Life (FLZ).

<table>
<thead>
<tr>
<th></th>
<th>NF1 no ADHD (n = 26)</th>
<th>NF1 with ADHD (n = 22)</th>
<th>ADHD no NF1 (n = 27)</th>
<th>M</th>
<th>SD</th>
<th>M</th>
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<th>M</th>
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<th>p</th>
<th>η²</th>
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</thead>
<tbody>
<tr>
<td><strong>Satisfaction with . . .</strong></td>
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<tr>
<td>General health</td>
<td>3.73 ±1.45</td>
<td>2.23 ±1.54</td>
<td>2.81 ±1.41</td>
<td>.003</td>
<td>.15</td>
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<tr>
<td>Career and trade</td>
<td>4.77 ±1.66</td>
<td>3.95 ±2.16</td>
<td>3.54 ±1.84</td>
<td>ns</td>
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<tr>
<td>Financial position</td>
<td>5.35 ±1.88</td>
<td>4.50 ±1.37</td>
<td>3.96 ±2.12</td>
<td>&lt;.027</td>
<td>.10</td>
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<tr>
<td>Free time and leisure</td>
<td>5.42 ±1.65</td>
<td>4.23 ±2.20</td>
<td>3.89 ±1.65</td>
<td>&lt;.009</td>
<td>.12</td>
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<tr>
<td>Marriage/partnership</td>
<td>4.73 ±1.95</td>
<td>4.60 ±2.55</td>
<td>3.95 ±1.96</td>
<td>ns</td>
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<tr>
<td>Own children</td>
<td>5.00 ±1.51</td>
<td>4.11 ±2.26</td>
<td>4.53 ±2.53</td>
<td>ns</td>
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<tr>
<td>Self-satisfaction</td>
<td>3.92 ±1.72</td>
<td>2.77 ±1.80</td>
<td>2.48 ±1.50</td>
<td>&lt;.006</td>
<td>.13</td>
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<td>Sexuality</td>
<td>4.48 ±1.61</td>
<td>3.09 ±1.71</td>
<td>3.70 ±1.92</td>
<td>&lt;.030</td>
<td>.09</td>
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<tr>
<td>Family/acquaintances</td>
<td>5.00 ±1.67</td>
<td>3.68 ±1.64</td>
<td>3.22 ±1.87</td>
<td>&lt;.001</td>
<td>.17</td>
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<tr>
<td>Living situation</td>
<td>5.85 ±1.38</td>
<td>5.23 ±2.28</td>
<td>4.01 ±1.42</td>
<td>&lt;.012</td>
<td>.12</td>
<td></td>
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<tr>
<td>Overall life satisfaction</td>
<td>4.77 ±1.45</td>
<td>3.05 ±1.62</td>
<td>2.89 ±1.70</td>
<td>&lt;.001</td>
<td>.23</td>
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</table>

Note: FLZ = Questionnaire on Life Satisfaction; NF1 = neurofibromatosis type 1. Scores are in Stanine values: $M = 5$, $SD = 2$; high scores imply satisfaction in life. Bold values are not within normal range.

*Homogeneous groups.

*Summation of subscales, excluding the following subscales: Work/Trade, Marriage/Partnership and Children.
Second, we wanted to test whether ADHD in adults with NF1 impacts life satisfaction. The FLZ is considered a measure of state levels of life satisfaction over multiple domains. High values indicate good psychosocial adjustment. Here, the NF1 no ADHD reported higher levels of life satisfaction than the ADHD groups in all scales (see Table 4). Our data revealed that ADHD symptoms had a statistically significant impact on overall life satisfaction, especially affecting general health, the self-satisfaction, sexuality, and family/acquaintances. Our findings indicate the importance of ADHD in adults with NF1 because of its impairing effect on life satisfaction. ADHD in the general adult population is also associated with poorer quality of life (Chao et al., 2008) and lower life satisfaction (Gudjonsson, Sigurdsson, Smari, & Young, 2008). Our study presents similar results, which highlight the importance of disease-related cognitive problems, such as attention problems and/or learning disabilities as quality of life impairing variable. Next to medical complications and disease-associated physical appearance as analyzed in previous studies (Page et al., 2006; Wolkenstein et al., 2001; Wolkenstein et al., 2003), future research needs to include these quality of life impairing difficulties. Due to the small sample size, we expected that we would not have the necessary power to show an additional effect of disease severity and visibility.

Given that the NF1 literature has noted a shift toward lower general IQ and a higher incidence of mental retardation in children with NF1 (Ferner et al., 1996), it is important to note that for this study, NF1 participants with an IQ lower than 85 were excluded. In addition, there were nonsignificant mean IQ score differences between two NF1 groups. The fact helps us assure that it is the impact of ADHD, not lower intellectual functioning, which is reflected in the personality and life satisfaction scales. Curiously, the ADHD no NF1 group had elevated mean IQ scores over all three IQ values. This can partly be explained by the fact that these participants were privately insured patients, which indicates higher income levels and indirectly higher education. The educational level was also higher in this sample. This higher IQ level did not alter the effects of ADHD on their responses as the participants with ADHD scored similar on all other measures when compared with the NF1 no ADHD group. The ADHD diagnosis according to DSM-IV was confirmed with the two rating scales designed to measure adult symptoms of ADHD. Due to the applied ADHD measures, we did not discriminate between the subtypes of ADHD, which is a limitation of our study, especially as the primarily hyperactive/impulsive subtype seems to be underrepresented in children with NF1 (Hyman et al., 2005). However, in our study, there were no significant differences between the two groups with ADHD in the ADHD measures indicating similar behavioral phenotypes independent of NF1. Both the groups with ADHD had significantly higher scores on a measure of depression; however, none of the three groups had depressiveness scores within the depressed range of functioning, thus lacking clinical relevance. Higher scores of depressiveness as rated by BDI has been noted in adults with ADHD in general (Steer, Ranieri, Kumar, & Beck, 2003). The authors of this study also showed that higher scores in BDI, especially in the items reflecting concentration difficulty (with the highest predictive value), past failure, and agitation, were indicative of ADHD in adults. Thus, the data further highlight that participants with ADHD differed from those with NF1 and no ADHD.

Previous studies have demonstrated a high incidence of ADHD within children with NF1 (Barton & North, 2004; Hyman et al., 2005; Mautner et al., 2002; Payne et al., 2011). Due to the persisting nature of ADHD in many adults in the general population (Kessler et al., 2006), we may have to consider these symptoms persisting in adult life in an NF1 population as well. Our study confirms that ADHD symptoms can persist in adults with NF1. The data show that ADHD in NF1 has significant impact on life satisfaction comparable with ADHD in the general population. These findings are important for treatment by neurologists and psychiatrists in this patient cohort, and the ADHD diagnosis should be considered for care of patients with NF1 in relation to the specific needs associated with other NF1 symptoms. Adults with NF1 and ADHD have a lower quality of life satisfaction and are less emotionally stable than adults with NF1 alone, indicating that these patients may need psychological and social care, and/or medical treatment. Further research should, therefore, focus on medical treatment of adults with NF1 as previous studies have shown that methylphenidate has a positive effect on ADHD symptoms in children with NF1 (Mautner et al., 2002).

Declaration of Conflicting Interests
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Note
1. Scores four to six are mean range levels reflecting 54% of the population scoring within those scores. Scores are standardized by gender and age.

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Author Biographies
Victor-Felix Mautner is a professor of research in tumor biology, head of phacomatosis section and a physician for neurology and psychiatry at the University Medical Center, Hamburg. He is a leading expert in neurofibromatosis.
Sofia Granström received her degree in psychology at the University of Hamburg. She is currently undergoing further qualification in cognitive behavioral therapy and her areas of research are NF1 patients’ health care situation, and their psychological and social burdens.
Robert A. Leark, Ph.D. is a professor of forensic psychology at Alliant International University in San Diego. He is active in research of the neuropsychological aspects of ADHD and NF1.