A re-examination of the rate of vocational dysfunction among patients with anosmia and mild to moderate closed head injury

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Abstract

This study sought to verify two earlier reports that up to 93% of patients with closed head injury (CHI) and anosmia are vocationally dysfunctional due to executive impairments associated with orbitofrontal damage. Participants were 11 men and 4 women identified from a pool of 60 potential subjects referred for evaluation of trauma-related chemosensory dysfunction at the University of Pennsylvania Smell and Taste Center from 1988 to 1994. These 15 subjects met four criteria: (i) willingness to complete a brief semi-structured interview concerning their pre- and post-CHI work history; (ii) age <60 years; (iii) evidence of mild to moderate CHI; and (iv) scores on the University of Pennsylvania Smell Identification Test indicative of anosmia or severe microsmia and non-malingering. In contrast to the earlier reports, only 7% of the subjects were vocationally dysfunctional. This study calls into question previous reports suggesting that anosmia is a reliable predictor of post-CHI vocational outcome. © 2001 National Academy of Neuropsychology. Published by Elsevier Science Ltd.

Keywords: Anosmia; Closed head injury; Vocational dysfunction

Disturbance in olfactory functioning and poor vocational recovery may be sequelae of closed head injury (CHI) (Prigatano, 1986; Costanzo et al., 1992), and both have been associated with damage to the orbitofrontal cortices (Doty et al., 1997; Malloy et al., 1993; Varney & Menefee, 1993; Yousem et al., 1996). Behavioral deficits associated with

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orbitofrontal damage are among the strongest predictors of vocational dysfunction (Crepeau & Scherzer, 1993), and yet may be difficult to detect using traditional neuropsychological tests (Brown, 1985). Also, subtle cortical damage may go undetected on neuroimaging (Dikmen & Levin, 1993). Thus, the discovery of an easily assessed indicator of possible orbitofrontal damage and predictor of poor vocational recovery should be clinically useful.

Two studies reported a remarkably high prevalence of vocational dysfunction in patients with CHI-related anosmia (CHI-anosmia), even among subjects who, for the most part, seemed cognitively intact. The first of these studies (Varney, 1988) reported vocational dysfunction — defined as being employed less than 25% of the time after receiving medical clearance to return to work — in 93% of patients with total anosmia and in 54% of those with partial anosmia. Unfortunately, no quantitative olfactory testing was performed. None of the 64 patients with total or partial anosmia had a WAIS FSIQ below 90 or performed below the 20th percentile on memory testing; and no patient exhibited anosmia, alexia, agraphia, acalculia, constructional apraxia, or neglect. Given this and other information in the report, it appears that the severity of CHI in this sample would usually be classified as relatively mild. Varney’s results are frequently cited in legal settings and within the scientific literature (e.g., Richardson, 1990; Crepeau & Scherzer, 1993; Malloy et al., 1993; Varney & Menefee, 1993; Lezak, 1995).

Martzke et al. (1991) performed a partial replication and extension of Varney’s original study and found vocational dysfunction in 80% of 20 totally or partially anosmic CHI subjects. All subjects had been medically cleared to return to work for at least 2 years prior to being referred for neuropsychological evaluation. Olfaction was measured by “rough and ready” (p. 215) qualitative means rather than by quantitative methods. Patients’ frontal symptoms were evaluated by interview with someone familiar with the patient using the Iowa Collateral Head Injury Interview. All patients also completed a basic neuropsychological test battery, including a series of tests purportedly sensitive to frontal lobe damage, such as Lezak’s Tinkertoy Test (TTT) (Lezak, 1982, 1995). The authors reported that most of the subjects appeared “psychometrically intact” (pp. 220–221). The TTT was the only test of frontal ability that most subjects (12 of 20) failed. Collateral interview suggested that the patients experienced considerable psychosocial handicaps of a type consistent with orbitofrontal damage (e.g., poor empathy, poor judgment, and impulsivity). The authors concluded that their results replicated and extended Varney’s (1988) findings not only by demonstrating the predictive utility of anosmia for vocational dysfunction, but by providing evidence that patients who have anosmia secondary to CHI demonstrate neurobehavioral deficits that are consistent with orbitofrontal damage.

Thus, Varney et al. may have uncovered an easily assessed, and potentially powerful marker (i.e., anosmia) of orbitofrontal damage and vocational dysfunction following CHI,

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1 Martzke et al. (1991) asked patients to identify a freshly opened jar of peanut butter held 2 in. from their nose with their eyes closed. Only those who could not smell anything were included in their study. According to Costanzo et al. (1992), the use of coarse methods of assessing olfaction such as this are not uncommon, and may provide adequate means of detecting total bilateral anosmia. However, Costanzo et al. noted that standardized olfactory tests provide more careful and thorough assessments, and also permit quantification of the degree of olfactory impairment.
even among individuals who seem to have suffered only a mild injury and who perform normally, or relatively well, on frequently used neuropsychological tests. Such a possibility, however, should be viewed in light of certain methodological considerations. Among other things, sampling and olfactory assessment methods could have created problems with representativeness. For example, it appears that most or all subjects in both studies were referred for neuropsychological evaluation. Presumably, the subgroup of CHI-anosmics who receive neuropsychological assessment do so because of concerns about their adaptive functioning, and thus may not match, or perhaps even resemble too closely, the overall population of CHI-anosmics. Concerns about adaptive functioning may be less, or far less frequent among many or most of the CHI-anosmics referred for olfactory assessment. Moreover, although the individuals in these studies could comprise an exceptional subgroup, the rates of vocational dysfunction reported for the CHI-anosmics are much higher than expected based on typical markers of injury severity. More recent and rigorous studies suggest that mild CHI produces a minimal increase in the likelihood of unemployment (Levin et al., 1987; Dikmen et al., 1989; Van Zomeren & Saan, 1990). Indeed, the rates of vocational dysfunction found in Martzke et al.’s (1991) sample, and especially in Varney’s (1988) sample, are as high or higher than frequencies reported in studies of severe head injury (Oddy & Humphrey, 1980; Richardson, 1990). Possible overestimation of the association among CHI, anosmia, and vocational dysfunction could have important implications because, on the basis of these earlier reports, a clinician may take anosmia, even in relative isolation, as a strong predictor of vocational dysfunction in a head injury case.

The intent of the present study was to re-examine the rate of vocational dysfunction among patients with anosmia associated with mild to moderate CHI. This study used archival data and supplemental interview of a sample of CHI patients who suffered mild to moderate head injuries. These patients were referred for chemosensory dysfunction rather than for neuropsychological evaluation and were shown to be totally anosmic or to have severe olfactory impairment (severe microsmia) on more comprehensive, standardized measures of olfaction, i.e., the University of Pennsylvania Smell Identification Test (UPSIT) and other tests.

Based on background knowledge about head injury and on the working assumption that a sample of post-CHI olfactory-dysfunctional patients referred for chemosensory dysfunction would be more representative of all post-CHI olfactory dysfunctional patients, it was hypothesized that a substantially lower rate of unemployment would be found.

1. Method

1.1. Participants

Given our analysis of power, our initial aim was to recruit about 20 suitable subjects. In order to do so, we started with an overly inclusive pool of 256 subjects who had been evaluated at the University of Pennsylvania Smell and Taste Center (UPSTC) from 1981 to 1994 for olfactory dysfunction associated with head trauma. As more fully described below, we then eliminated inappropriate subjects, that is, those who: (a) were above 60 years of age, (b) experienced either severe head injury or may have suffered a minimal or negligible head
injury, (c) had not demonstrated total or severe anosmia, or (d) showed evidence of malingering during smell assessment. Also, subjects whose olfactory function may have antedated head injury were eliminated. This left 158 potentially suitable subjects, considerably more than we needed. Thus, from this 158, we selected the 60 that had been evaluated most recently, or since 1988, as these subjects would likely be easier to locate.

1.2. Procedure

Archival review of UPSTC patient files yielded information on subjects’ standings on demographic variables; UPSIT scores and olfactory diagnosis (e.g., anosmic, microsmic, hyposmic, etc.); date of evaluation; CHI data including date, cause, severity of CHI, and age at time of injury; and evidence of involvement in injury-related litigation. The UPSIT, commercially known as The Smell Identification Test® (Sensonic, Hadden Heights, NJ), is a widely used standardized test of olfactory functioning (Doty, 1992). This 40-item scratch-and-sniff, multiple-choice, test has sound test–retest reliability, high internal consistency, and norms that are adjusted for age and gender (Doty, 1992, 1995). The UPSIT has a cut-off score for probable malingering based on expected performance for someone responding randomly to the items.

Subjects who were 60-years-old or older at the time of their UPSIT evaluation were excluded because at this age, normal males begin to show a decline in olfactory function on the UPSIT. Although this phenomenon does not typically begin until age 65 for females, the 60-year-old cut-off was maintained across gender in order to achieve age consistency and to prevent a possible confound for age vs. gender with regard to employment status. For example, since older age is a risk factor for poor CHI outcome (Williamson et al., 1996), including older females in the sample might have biased unemployment rates.

Determination of CHI severity was based on archival records in accordance with criteria set forth by Jennett and Teasdale (1981), which utilize the presence of loss of consciousness (LOC), post-traumatic amnesia (PTA), or other clinical or historical evidence, such as the presence of intracranial hematoma. We included subjects with moderate CHI to ensure that injury severity in the final sample would at least equal, if not exceed, that seemingly extant in Varney’s (1988) and Martzke et al.’s (1991) samples.

After application of the exclusion and inclusion criteria, 158 subjects remained, from which we selected, as noted, the 60 most recently evaluated subjects. Invitations to participate were mailed to these 60 individuals. Participants completed a semi-structured telephone interview, conducted by the principal investigator, which sought to gather new data and to verify and expand upon information gleaned from the UPSTC files. The interview queried subjects’ demographic information, head injury history, source of UPSTC referral, current olfactory status, pre- and post-injury work history (including, if applicable, circumstances

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2 For the purposes of this study, UPSIT scores were used as the index of olfactory capacity. However, all subjects had an overall UPSTC olfactory diagnosis consistent with their UPSIT score. The UPSTC evaluation procedures include, but are not limited to, detailed history taking, administration of the UPSIT, and olfactory threshold testing.

3 A full version of the interview is available upon request.
surrounding retirement), and sources of income. We adopted Varney’s (1988)\textsuperscript{4} criterion for vocational dysfunction: being employed 25% of the time or less after being medically cleared to return to work. For all subjects in the present study, at least 2 years had passed between the time of their UPSTC evaluation and our data collection. Thus, sufficient time had lapsed since their CHI to allow them to establish a post-injury work history.

2. Results

Of the 60 potential subjects, one was deceased and one denied having anosmia associated with CHI. Of the remaining 58, 21 subjects provided informed consent and were interviewed. Six of these subjects, however, were later removed from the analysis because their interview data suggested that they either had had no CHI at all (i.e., no traumatic brain injury), that their injury was extremely mild, or that the CHI might not have been the sole etiology for their anosmia. This resulted in a final sample of 15 subjects. Since application of the inclusion and exclusion criteria revealed that only 52 of the 60 invitees were actually eligible to participate (i.e., 60 invitees minus 1 deceased, 1 without CHI-anosmia, and 6 excluded), our participation rate was 29%, or 15 of 52. The remaining invitees who did not participate are accounted for as follows: 13 of the 60 mailed packets were undeliverable, 21 did not respond to the letter and attempts to contact them otherwise were unsuccessful, and three others declined to participate. Thus, in effect, 24 rejected participation.

The final sample consisted of 11 men and 4 women; 14 were Caucasian and 1 was Hispanic; the mean age at the time of data collection was 49.86 years (SD = 15.34); and the mean level of education was 14.5 years (SD = 2.26). All 15 subjects were evaluated at the UPSTC between January of 1988 and March of 1994. The source of their UPSTC referral is summarized in Table 1. The sample did not differ significantly from that of Martzke et al. (1991) in terms of age (t(33) = 1.84, p > 0.05) or years of education (t(33) = 1.63, p > 0.05).\textsuperscript{5} On average, however, our sample was somewhat older and had slightly more education than that of Martzke et al.’s. Varney (1988) did not report these sample characteristics. Fourteen subjects were classified as anosmic according to the UPSIT and other tests and one was classified as “severely microsmic.” For 14 of the 15 subjects, duration between time of injury and evaluation at the UPSTC ranged from 1 to 36 months, with a modal duration of 6 to 12 months. For the remaining subject, this duration was 17 years. Four subjects reported improvement in their olfactory functioning since the date of their UPSTC evaluation but

\textsuperscript{4} Dr. Varney was contacted about this project and his input was sought before finalizing the research protocol. Specifically, he was asked to provide any additional demographic information on the subjects used in the 1988 and 1991 studies; to indicate the number of subjects in both studies, if any, who were involved in litigation, and who were referred for neuropsychological evaluation by an attorney; and to clarify the method used to detect anosmia, including any formal or standardized protocols used. Dr. Varney discussed his findings on the relationship among anosmia, orbitofrontal damage, and vocational outcome following CHI. He indicated that the UPSIT was not used to determine anosmia in his studies. Dr. Varney indicated that the subjects in his study were drawn from a cadre of patients in a depression study. Additionally, Dr. Varney expressed reservations about some of the methods used in the present study.

\textsuperscript{5} t-Tests were derived by algebraic manipulation of data reported by Martzke et al. (1991).
continued to experience deficits; and 11 reported no improvement in olfactory functioning. Although recovery of olfactory function beyond 1 year post-injury is not expected, it is not inconsistent with Sumner’s (1964,1976) observations. The majority of CHIs in our sample were to the back of the head and resulted from falls. Four subjects reported no LOC but had other indicia of at least mild, if not moderate, head injury, such as intracranial hematoma or relatively protracted PTA. Among the remaining subjects, reported LOC, PTA, and other indicia of injury severity suggested mild CHI in the majority and moderate CHI among a sizable minority (about 25% of the overall sample). Head injury information is summarized in Table 2. Subjects’ occupations are summarized in Table 3.

No gross discrepancies were uncovered between data obtained from the medical record and those obtained by telephone interview for any subject. For example, CHI information obtained during interview was consistent with the more contemporaneous UPSTC data. (Although, because some of the UPSTC data were also based on self-report, it is possible that some subjects were consistently inaccurate.)

Only one subject (7%) met criteria for vocational dysfunction. Thus, 14 of the 15 (93%) subjects failed to meet criteria for vocational dysfunction. There was no discernible relation-

### Table 1

<table>
<thead>
<tr>
<th>Source</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician</td>
<td>6 (40)</td>
</tr>
<tr>
<td>Self-referred</td>
<td>3 (20)</td>
</tr>
<tr>
<td>Patient’s attorney</td>
<td>3 (20)</td>
</tr>
<tr>
<td>Physician and patient’s attorney</td>
<td>1 (7)</td>
</tr>
<tr>
<td>Opposing insurance company</td>
<td>2 (13)</td>
</tr>
</tbody>
</table>

### Table 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cause of injury</td>
<td>Falls</td>
<td>9 (60)</td>
</tr>
<tr>
<td></td>
<td>MVA</td>
<td>3 (20)</td>
</tr>
<tr>
<td></td>
<td>Bicycle</td>
<td>1 (7)</td>
</tr>
<tr>
<td></td>
<td>Sports injury</td>
<td>1 (7)</td>
</tr>
<tr>
<td></td>
<td>Hit by car</td>
<td>1 (7)</td>
</tr>
<tr>
<td>Location of injury</td>
<td>Face/frontal</td>
<td>3 (20)</td>
</tr>
<tr>
<td></td>
<td>Occipital</td>
<td>8 (53)</td>
</tr>
<tr>
<td></td>
<td>Temporo-parietal</td>
<td>2 (13)</td>
</tr>
<tr>
<td></td>
<td>Uncertain</td>
<td>2 (13)</td>
</tr>
<tr>
<td>Duration of LOC</td>
<td>None reported</td>
<td>4 (26)</td>
</tr>
<tr>
<td></td>
<td>≤ 0.25 h</td>
<td>7 (47)</td>
</tr>
<tr>
<td></td>
<td>&gt;0.25 ≤ 1 h</td>
<td>1 (7)</td>
</tr>
<tr>
<td></td>
<td>&gt;1 ≤ 2 h</td>
<td>2 (13)</td>
</tr>
<tr>
<td></td>
<td>&gt;2 ≤ 4 h</td>
<td>1 (7)</td>
</tr>
</tbody>
</table>

a Percentages do not necessarily sum to 100% due to rounding.

b Other indicia of CHI severity were reported.
Table 3
Summary of vocational status

<table>
<thead>
<tr>
<th>Vocational status</th>
<th>Main pre-CHI occupation</th>
<th>Main occupation at time of data collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dysfunctional ((n = 1))</td>
<td>Advertising</td>
<td>Retired due to CHI sequelae</td>
</tr>
<tr>
<td>Employment difficulty ((n = 3))</td>
<td>Construction worker</td>
<td>Various jobs</td>
</tr>
<tr>
<td></td>
<td>Editorial officer</td>
<td>Associate Editor</td>
</tr>
<tr>
<td></td>
<td>Real estate appraiser</td>
<td>Real estate appraiser</td>
</tr>
<tr>
<td>Vocationally functional ((n = 11))</td>
<td>Construction supervisor</td>
<td>Retired(^a)</td>
</tr>
<tr>
<td></td>
<td>Aviation engineer</td>
<td>Retired(^a)</td>
</tr>
<tr>
<td></td>
<td>Food product developer</td>
<td>Retired(^a)</td>
</tr>
<tr>
<td></td>
<td>Teacher</td>
<td>Teacher</td>
</tr>
<tr>
<td></td>
<td>General contractor</td>
<td>General contractor</td>
</tr>
<tr>
<td></td>
<td>Medical secretary</td>
<td>Medical secretary</td>
</tr>
<tr>
<td></td>
<td>Production Supervisor</td>
<td>Production Supervisor</td>
</tr>
<tr>
<td></td>
<td>Dental hygienist</td>
<td>Dental hygienist</td>
</tr>
<tr>
<td></td>
<td>Student</td>
<td>Assistant buyer</td>
</tr>
<tr>
<td></td>
<td>Student</td>
<td>Park Ranger</td>
</tr>
<tr>
<td></td>
<td>Student</td>
<td>Bartender</td>
</tr>
</tbody>
</table>

\(^a\) Subject established a positive post-CHI work history.

ship between occupation and extent of vocational dysfunction. The one vocationally dysfunctional subject reportedly sought early retirement after employment was terminated following CHI, and expressed a view that successful re-employment was improbable due to poor concentration, increased irritability, and other personality changes. The subject reported a period of altered consciousness and other features suggestive of moderate CHI. This case resembles the profile that Varney presented concerning the relation among CHI, anosmia, orbitofrontal cortical damage, and its psychosocial sequelae (Varney, 1988; Martzke et al., 1991; Varney & Menefee, 1993; Malloy & Richardson, 1994; Malloy et al., 1993), although such problems are not unique to frontal injury. Further, this subject’s difficulties were not isolated but co-occurred with other indicia of CHI.

Three of the 14 vocationally functional subjects reported employment-related difficulties following CHI but did not meet formal criteria for vocational dysfunction. These subjects complained of decreased work efficiency, with difficulty concentrating and slowed, effortful thinking. Two of these three subjects seem to have had moderate CHI. One subject, the second most adversely affected in the sample, was unable to return to his pre-CHI job. Rather, he was employed about 8–9 months a year in various seasonal and temporary jobs with periods of unemployment. Another subject returned to the same job but reported persistent decreased efficiency, with associated decrease in income. The last subject recovered from transient decreased work efficiency and was subsequently promoted. Three subjects were retired at the time of data collection but had established a positive post-CHI work history of 6 to 19 years at the same prior occupation and denied that their retirement was related to their CHI.

Disregarding changes in income due to retirement, three subjects reported a decrease in income post-CHI, seven reported no change, and five reported an increase. Three subjects
reportedly received job promotions at some point after their CHI. No subject who became eligible for, or who applied for, a promotion after CHI was turned down. All subjects denied having ever been fired from any pre-CHI job (including those who were students and held part-time or summer jobs at the time of their CHI). These findings suggest that this sample, as a whole, had positive employment histories both before and after their head injury.

Across referral sources, UPSTC results were eventually used in some form of CHI-related litigation among about half the respondents (eight subjects, 53%). Of these eight subjects, six reported being awarded financial compensation, but all six stated that their award did not provide enough money on which to live.

To examine the relationship between financial need and employment status, we asked subjects to disclose the sources (but not the amount) of their income. Fourteen subjects reported a financial need to work irrespective of whether they had supplemental sources of income, such as retirement benefits or an anosmia-related legal settlement. Only one subject reported having no financial need to work (due in part to a legal settlement) but, nevertheless, was employed in two part-time jobs, which combined for nearly full-time employment.

On interview, several subjects spontaneously described negative effects of anosmia and, in most cases, the accompanying loss of flavor sensation, on the quality of their lives. Anosmia-related job problems included being unable to distinguish between chemical solutions and solvents, difficulty working with food, and inability to recognize the hygienic needs of others in their care. Subjects also complained of inability to properly taste food or to detect perfume, spoiled food, burning materials, or natural gas. Some subjects felt that others, including medical and legal professionals, minimized their loss of olfaction.

3. Discussion

In this sample referred to the UPSTC for evaluation of anosmia associated with mild-to-moderate CHI, the rate of vocational dysfunction was dramatically lower than what Varney (1988) reported in a sample of CHI-anosmics, specifically, 7% vs. 93%. The present results were also dramatically lower than the 80% rate of vocational dysfunction Martzke et al. (1991) reported in a partial replication of Varney’s study. The current findings suggest that the association between CHI-anosmia and vocational dysfunction may not be as strong as Varney and his colleagues have reported, for if it were, one would not expect, even in a sample as small as ours, to find such a high employment rate. The severity of brain injury in the current sample appears to have been equal to or greater than that seemingly extant in Varney’s and Martzke et al.’s samples, and thus probably cannot explain the discrepancy. Our results also comport with the general finding that the great majority of individuals who have mild CHI return to work within 3 months to 1 year following injury (Gronwall & Wrightson, 1974; Levin et al., 1987; Dikmen et al., 1989; Van Zomeren & Saan, 1990), and suggest that the presence of anosmia resulting from mild to moderate CHI is not, by itself, a reliable predictor of subsequent vocational dysfunction. In fact, even in the case of the one subject who met criteria for vocational dysfunction, various factors (e.g., questionable treatment compliance) could be used to argue for or against the link between employment and brain status.
Some of the subjects in our sample held high-level pre-CHI jobs, such as aviation engineer, and academic journal editor. One might expect that such positions have heavy cognitive demands, without much latitude for error, yet all of these subjects reported successful return to work. Three subjects reported transient or persistent decreased work efficiency following CHI due to factors such as decreased concentration and slowed, effortful thinking. Also, at least three subjects, two of whom were among the more severely injured members of our sample, reported an adverse impact on earnings. Most subjects, however, reported unchanged or increased earnings after CHI. No subject was denied or passed over for a promotion. Thus, our sample seemed to have little hidden vocational dysfunction, e.g., patients who returned to work but at lower status, or who were denied promotion because of lowered post-CHI job performance.

It is possible that the potential subjects who either did not respond or declined to participate in our study could have been less functional than those who did participate. That is, decreased functioning could be associated with economic hardship, changed residency, or other factors that increase the probability of being lost to follow-up. However, given that the severity of injury among these subjects was also mild to moderate, and considering previous research suggesting generally positive occupational outcome following mild head injury (e.g., Dikmen et al., 1989), it would be unexpected that most of these individuals are unemployed and, if so, that their unemployment could be reasonably attributed to their CHI. Even if one assumes that the 24 remaining individuals that did not participate were all appropriate subjects and had a 50% rate of unemployment — a rate more than seven times higher than that of the subjects we did study — the overall unemployment rate of 33% (1/15 + 12/24 = 13/39) is still far below that which Varney (1988) and Martzke et al. (1991) report.

There are several possible reasons for the discrepancy between the current findings and those of Varney (1988) and Martzke et al. (1991). In contrast to our sample, which was referred for anosmia, the CHI-anosmics comprising Martzke et al.’s sample (and quite possibly Varney’s sample) were referred for neuropsychological evaluation. CHI-anosmics referred for neuropsychological evaluation represent a subset of all CHI-anosmics, i.e., typically those who are suspected of suffering some type of cognitive, behavioral, or affective sequelae, and are thus more likely to have work difficulties (regardless of the causal directionality). Ironically, referral to a neuropsychological service may have been initiated, more than occasionally, because of work adjustment difficulties. Thus, the minority of mild CHI patients who have poor vocational outcome may have been overrepresented in Varney’s and Martzke et al.’s samples. Note, at the same time, that work adjustment difficulties are not rare in the general population, nor is mild head injury, and thus, co-occurrence of the two might not be a particularly unusual event either, even if there is a limited association.

In contrast, it seems likely that individuals referred for anosmia would be more representative of all anosmics (with or without head injury) than anosmics referred for neuropsychological testing. Nevertheless, it is possible that our sample was skewed in other ways (e.g., by socioeconomic status) that could have biased estimates of employment rates. That is, it is certainly possible that mild CHI patients with poor vocational outcome were underrepresented in our sample. Given this and our relatively small sample size, the frequency of vocational dysfunction we obtained clearly should not be considered exact. We also recognize that there may be a subset of individuals with
CHI that would be rated as mild or very mild according to typical severity indicators, but who are actually more severely injured and more functionally impaired, with anosmia serving as a marker of such exceptional cases. This, however, begs the question of how often such exceptions occur.

The possibility exists that for Varney’s and Martzke et al.’s subjects, inability to work might be explained by factors other than psychosocial or executive sequelae of orbitofrontal damage, such as involvement in litigation, amount of economy-based vocational opportunity, pre-injury occupational and educational status, pre-morbid personality characteristics, pre-morbid psychopathology, concomitant injury, concomitant psychopathology such as depression or conversion disorder, secondary gain, and iatrogenic disorder, all of which may be related to vocational outcome following CHI (Oddy & Humphrey, 1980; Prigatano, 1986; Prigatano & Fordyce, 1986; Van Zomeren & Saan, 1990; Crepeau & Scherzer, 1993; Dikmen & Levin, 1993). In short, Varney’s and Martzke et al.’s samples may have been skewed toward inability to work for a variety of reasons including, but not limited to, orbitofrontal damage.

About half of the subjects in the current sample reported involvement in litigation regarding their CHI and anosmia, and UPSTC verification of their anosmia may well have bolstered their legal claims. Although seeking injury compensation through litigation has an unclear impact on vocational rates (Crepeau & Scherzer, 1993), it surely cannot be considered a positive incentive to work, precisely because it may provide a financial incentive not to work and/or to report work difficulties. Despite this, our subjects’ work status was not inversely related to their involvement in litigation. This observation raises the possibility that our sample was somehow skewed in a direction that created unusual or atypical incentives to work, or that greatly diminished the probability of work dysfunction. Neither Varney (1988) nor Martzke et al. (1991) report the percentage of subjects in their samples who were involved in litigation either before, during, or after their data were collected. Therefore, direct comparison of the samples on this basis is precluded. We do not believe, however, that differences across studies are likely to be explained by malingering. It seems implausible that Varney’s and Martzke et al.’s subjects would have selectively malingered anosmia, inability to work, and (in the case of Martzke et al.’s sample), impairment on the TTT, while doing well on most other neuropsychological tests. Such a scenario seems even less plausible when one considers how neatly such an occurrence would have supported their hypothesis.

Martzke et al. (1991) collected data from collateral sources on the psychosocial functioning of their subjects. We did not obtain such data, and this represents a possible weakness in our study. However, given the high rate of consistency between our subjects’ interview and archival data, and their generally high level of vocational functioning, it seems rather unlikely that these subjects had significant post-CHI psychosocial impairment or lack of awareness of deficit.

A secondary but noteworthy finding of this study was the degree to which some subjects reported that their anosmia (and accompanying loss of flavor sensation in many cases) had diminished the quality of their lives. Some subjects expressed frustration with the lack of empathy that others extended to them. There was a general sense among subjects that others minimized their olfactory dysfunction.
In summary, the main finding of this study calls into question the assertion of Varney (1988) and Martzke et al. (1991) that anosmia associated with CHI is a strong marker of vocational dysfunction related to orbitofrontal cortical damage. This does not rule out the usefulness of anosmia as a possible indicator of orbitofrontal damage, nor does it disconfirm a predictive link between CHI-anosmia, orbitofrontal damage, and vocational dysfunction in some cases. Indeed, the results of Varney’s and Martzke et al.’s studies, as well as the reports of some subjects in the present study, suggest that some degree of association may exist. Moreover, Varney’s clever hypothesis makes anatomic and neurobehavioral sense, especially when one considers the purported role of the orbitofrontal–subcortical neurocircuitry in regulating social behavior (Malloy & Richardson, 1994; Mega & Cummings, 1994) and the importance of social appropriateness in work settings. The results of the present study do, however, suggest that any such link between CHI-anosmia and vocational dysfunction may well be weak and unreliable, and that the presence of CHI-anosmia, by itself, should not be used to predict vocational dysfunction, especially among individuals who have had successful pre-CHI employment or education histories. Moreover, it should not be relied on too heavily to explain or guide differentiation of factors associated with work dysfunction, and hence, in the design of treatment for work complaints. This conclusion must be tempered by potential methodological obstacles that could have operated in this study, such as a possible volunteerism effect, a relatively small sample size, or a sample that was, in some manner, skewed toward positive employment. It seems reasonable to propose that the rate of vocational dysfunction among those with mild CHI and anosmia but without gross or objective cognitive sequelae is lower, and perhaps considerably lower than that which Varney (1988) and Martzke et al. (1991) reported, but is quite possibly higher than what we found. Clarification will require a matched representative sample of individuals with mild CHI, some with and some without anosmia, a daunting task. In the meantime, clinicians should be cautious in assuming that anosmia in association with CHI is a bleak prognostic indicator for vocational adjustment, especially when it occurs in isolation, in which case it may not alter the odds of resuming gainful employment appreciably.

References


