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Evidence of Big-Five personality changes following acquired brain injury from a prospective longitudinal investigation

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ABSTRACT

Objective: Many studies using different assessment methods have reported personality changes after acquired brain injury (ABI). However, to our knowledge, no prospective study has yet been conducted to examine whether previous cross-sectional and retrospective results can be replicated in a longitudinal prospective design. Further, because clinical control groups were only rarely used, it remains debatable if the personality changes found are unique to patients with ABI or if they also affect patients with other disabilities.
Methods: This study examined personality change in 114 participants with different kinds of ABI, 1321 matched controls (general control, GC), and 746 matched participants with restrictive impairments other than brain injury (clinical control, CC) in a prospective longitudinal design using data from the panel survey Household, Income and Labour Dynamics in Australia (HILDA).
Results: Participants with ABI showed significantly larger declines in Extraversion and Conscientiousness compared with the GC group. When the ABI participants were compared with the CC group, only the difference in Conscientiousness remained significant.
Conclusion: Our prospective data corroborate evidence from previous cross-sectional studies that patients with ABI experience larger declines in Extraversion and Conscientiousness than the general population. Whereas the effect on Conscientiousness was unique to patients with ABI, the decline in Extraversion was also observed in participants with other impairments.

1. Introduction

Many studies have reported that acquired brain injury (ABI) can lead to personality changes [1–5]. These changes are typically associated with a worse psychosocial outcome [6,7], especially in terms of heightened depression and anxiety [8,9], reduced activities [10], increased social difficulties [11], and worse health-related quality of life [5]. Previous studies have assessed changes in personality after ABI in very different ways. Investigations focusing on changes in personality structure, as assessed by the Big Five dimensions (Neuroticism or Emotional Stability, Extraversion, Openness to Experience, Conscientiousness, and Agreeableness) [12], have reported a decline in Extraversion, Conscientiousness, or Emotional Stability [13,14,7,2,15] with a decrease in Extraversion being the most consistent finding.

However, these previous studies have suffered from two major methodological flaws: The main limitation of all previous approaches has been the retrospective nature of the designs. Retrospective data acquisition is supposed to be less accurate than prospective data acquisition because memory is affected by several biases including the current mood bias [16], the self-serving bias [17] or the fading affect bias [18]. Previous studies [14,7,2,15] have tried to limit these effects by assessing pre- and post-injury personality at separate points in time after injury. Even though the bias was not completely removed that way, this still led to reductions in reports of personality changes, underlining the concern that at least some of the effect might be due to a retrospective bias.

The second major methodological limitation of previous designs is related to the fact that most studies have lacked a clinical control group. This issue is especially important as a clinical control group may help to generate hypotheses about possible underlying causes of personality changes after brain damage. So far, most authors have suggested a neurological basis such as that damage to the frontotemporal or more specifically the ventromedial or orbital prefrontal cortex has caused personality change [19–21]. However, if personality changes found after ABI closely resemble those found in other medical conditions that do not involve brain damage, other causes should be discussed: Problems in psychosocial adjustment such as changes in social roles, a loss of personal goals, values that became unreachable, anxiety, and withdrawal from social activity might also be responsible for personality changes [22]. Lannoo et al.'s [13] and Rush et al.'s [7]

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studies, which found no differences in personality changes between individuals with ABI and those with other disabilities, suggest that personality changes are related to difficulties dealing with the disability rather than neurological causes.

To the best of our knowledge, the current study is the first to investigate the effects of ABI on personality using a prospective longitudinal design. Our aims were, first, to determine whether people with ABI experience stronger personality changes than the general population and whether we can replicate the results of previous retrospective studies in a prospective design. Second, we wanted to clarify whether personality changes are unique to patients with ABI or also affect patients with other restrictive impairments. In addition, we aimed to investigate whether the association between ABI and personality change would be mediated by a reduction in health-related quality of life (HRQoL). We expected to find no mediation effect for physical HRQoL but for mental HRQoL which is assumed to resemble problems in psychosocial adjustment. This finding would support the hypothesis that problems in psychosocial adjustment should be considered as one underlying reason for personality changes besides neurological causes.

2. Method

2.1. Participants

We used data from the Household, Income, and Labour Dynamics in Australia survey (HILDA). The HILDA panel study was initiated and is funded by the Australian Government Department of Social Services. It is subject to oversight and approval by the University's Office for Research Ethics and Integrity. With regard to the use of the data, all HILDA data users are required to sign the license agreement, which legally binds them to use the data for bona fide research purposes.

In this nationally representative panel survey, which began in 2001, individuals from more than 6500 Australian households are interviewed every year and fill out several questionnaires [23]. In 2005 (t_1) and 2009 (t_2), the interview included a Big Five questionnaire. Therefore, we used data from 2005 to 2009. Of the 16,373 people who participated in the survey between t_1 and t_2, we excluded people who had already reported ABI in t_1 or who had missing data on their t_1 health status, their education, or their personality at t_1 or t_2. Therefore, 8322 participants between the ages of 15 and 92 (3801 men and 4521 women) were included in the study.

2.2. Main outcome variable: personality

All participants filled out a 36-item scale based on Saucier's Mini Markers Scale [24] to assess their Big Five personality dimensions at t_1 and t_2. Each item consisted of a single adjective (e.g. "orderly", "shy"), and the respondents had to rate how well each adjective described them using a Likert scale that ranged from 1 (*does not describe me at all*) to 7 (*describes me very well*). On the basis of previous factor analyses and reliability analyses, eight adjectives had to be excluded due to simultaneous loadings on several factors [25]. The other adjectives were assigned to one of the Big Five dimensions. Participants who had answered less than 75% of the items for one dimension were excluded from the analyses (i.e. at most one item could be missing in each dimension). The participants had up to five missing values which were replaced by the mean of the other items. Over 95% of the participants had no missing values. We calculated *T*-scores using the data of all participants at t_1 ($N = 8322$) and used the difference between the t_2 personality *T*-score and the t_1 personality *T*-score as an indicator of personality change. Therefore, a negative change score represented a decline in the respective personality variable.

2.3. Main predictor variable: participants with acquired brain injury (ABI) and control groups

The respondents were asked every year for 5 years (i.e. 2005 = t_1, 2006, 2007, 2008, and 2009 = t_2) if they had any long-term health condition, impairment, or disability that restricted their everyday activities and that had lasted or was likely to last for 6 months or more. Respondents answering this question in the affirmative were then shown a list of medical conditions from which they had to name one or more, e.g. "hearing problems", "a nervous or emotional condition which requires treatment", or "chronic or recurring pain". One of the items from the list was "long term effects as a result of a head injury, stroke or other brain damage". This item was used to divide the dataset into a group with ABI and control participants. As already mentioned above, we excluded people who had already affirmed this item at t_1, because we were interested in analyzing personality change after having acquired a brain injury in a prospective design. Next we describe how participants were divided into three groups based on whether they had acquired a brain injury or another impairment between t_1 and t_2:

2.3.1. Patients with acquired brain injury (ABI)

The group of patients with an acquired brain injury (ABI, $n = 114$) contained all respondents who had at least once given an affirmative answer to the question about "long term effects as a result of a head injury, stroke, or other brain damage" at any of the four time-points after t_1 (but not at t_1). As the question did not differentiate between the various forms of brain injury, it was impossible to tell how many of these participants suffered a stroke, a traumatic brain injury, or another form of brain injury. These participants could also have other disabilities in addition to ABI.

2.3.2. Global control (GC) group

Our global control (GC) group ($n = 8208$) contained all other participants and therefore included healthy people as well as people with impairments other than ABI at any time-point. This group can be considered as representative of the population of Australia with the difference that people with ABI are excluded here.

2.3.3. Clinical control (CC) group

We additionally created a subgroup of the GC group that included only those participants who had acquired a disability after t_1 (clinical control (CC) group, $n = 3154$). These participants had indicated a newly occurring disability other than ABI from the list of medical conditions at any time-point after t_1, which had not already existed at t_1. They could however have had other kinds of pre-existing impairments at t_1.

2.4. Control variables and matching procedure

In a second step, we performed a matching procedure to create groups that are equal on several variables that could influence personality change, such as age, sex, education, preexisting impairments, baseline personality, and health-related quality of life (HRQoL).

2.4.1. Health-related quality of life (HRQoL)

The SF-36 Health Survey was used to assess health-related quality of life (HRQoL) on two global outcome scales: physical and mental HRQoL [26]. Both scales were transformed into *T*-scores using data from the general U.S. population [26] (with $M = 50, SD = 10$) with higher scores indicating better HRQoL. The respondents filled out the questionnaire annually. We used the SF-36 scores of 2005 (= t_1) and 2009 (= t_2). We calculated the difference between the t_2 SF-36 scores and the t_1 SF-36 scores to estimate changes in physical and mental HRQoL with negative values indicating a decline in HRQoL. Missing values were replaced by the mean of the other items from the subscale, only if more than 75% of the items were filled out. Over 94% of the participants had