



## ***Original article***

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# Current research in behavioral toxicology in Scandinavia

by Monica Hane, PhD,<sup>1</sup> Kerstin Ekberg, MA<sup>2</sup>

Solvents have, for a long time, been suspected to cause disturbances in memory, thinking, and the affective state. However, considerable problems arise when the relation between exposure in different occupations and permanent dysfunction in the central nervous system are under study. Both the findings and conclusions of different studies have been disputed.

Acute effects of solvent exposure have been demonstrated in several investigations, and these effects have rarely been questioned (4). Cross-sectional studies on long-term effects have also disclosed significant differences between exposed and nonexposed workers with regard to performance on psychological tests and to neuropsychiatric symptoms, but as a rule only very low correlations between dose and effect have been found. Detailed information about exposure has not been available, however, and dysfunction in the central nervous system has had to be studied by indirect methods. In none of the cross-sectional studies has the exposed group been without exposure for more than a few days, and therefore the acute and chronic effects cannot be distinguished.

In the few epidemiologic studies that have been conducted, different selection mechanisms and observational bias have been discussed, but the overall conclusion is that permanent neuropsychiatric symptoms are overrepresented among solvent-exposed workers.

Effective secondary prevention is based on the possibility of detecting early signs of dysfunction. It is therefore important to determine what mechanisms are at work. Knowledge about the mechanisms is also important for therapy and rehabilitation.

Several hypotheses have been put forward. One is that occupational exposure to industrial solvents causes *cerebral atrophy* equivalent to that which occurs after severe intoxication. Juntunen et al (5) reported that 64 % of patients exposed to industrial solvents showed changes indicating brain atrophy. Selection mechanisms can always influence results in clinical investigations, and excessive frequencies

of cerebral atrophy have not been shown in any epidemiologic study. The case-referent studies have embraced a wide variety of diagnoses (1, 7), including all kinds of neuropsychiatric diagnoses. In a cohort study (8) comparing painters with bricklayers, the pension-qualifying diagnoses were reclassified by the researchers, and a rater-specific diagnosis was used. The risk ratio was 3.5 for presenile dementia as the disability pension diagnosis.

Studies on animals indicate that the inhalation of thinner solvent may cause neuronal degeneration (11). *Structural damage* to the nervous system has also been demonstrated for other solvents, including carbon disulfide, n-hexane, and methyl butyl ketone (2).

Because histological changes are rare, many investigations are being directed towards the metabolic effects of solvent exposure. Up to now *metabolic dysfunction* has been studied only after short-term exposure, but prospective studies might yield important information about the mechanisms behind the chronic symptoms and signs (3, 9).

A number of studies indicate that the chemical structure of a solvent may be important. In particular the length of the carbon chain may influence the effect on biological membranes (10). Investigations on the biological and chemical mechanisms are necessary complements to the epidemiologic studies that have dominated in the past.

Psychologically based hypotheses have been put forward to explain the behavioral and symptomatic effects of solvents. One is that the acute effects of solvent exposure, such as tiredness, headache, and prolonged reaction times, *impair the ability to cope* with other stressors. It is assumed that ageing is not uniform for all individuals and that in all populations a certain proportion will be given the diagnosis of presenile dementia. According to this hypothesis, the proportion will be greater among the exposed, because the combination of ageing and the acute but reversible effect of solvents creates problems of coping with normal stressors.

A *neurotic mechanism* has also been suggested. Fear of brain dysfunction is said to be a highly significant stressor. Of 13 patients with the diagnosis of

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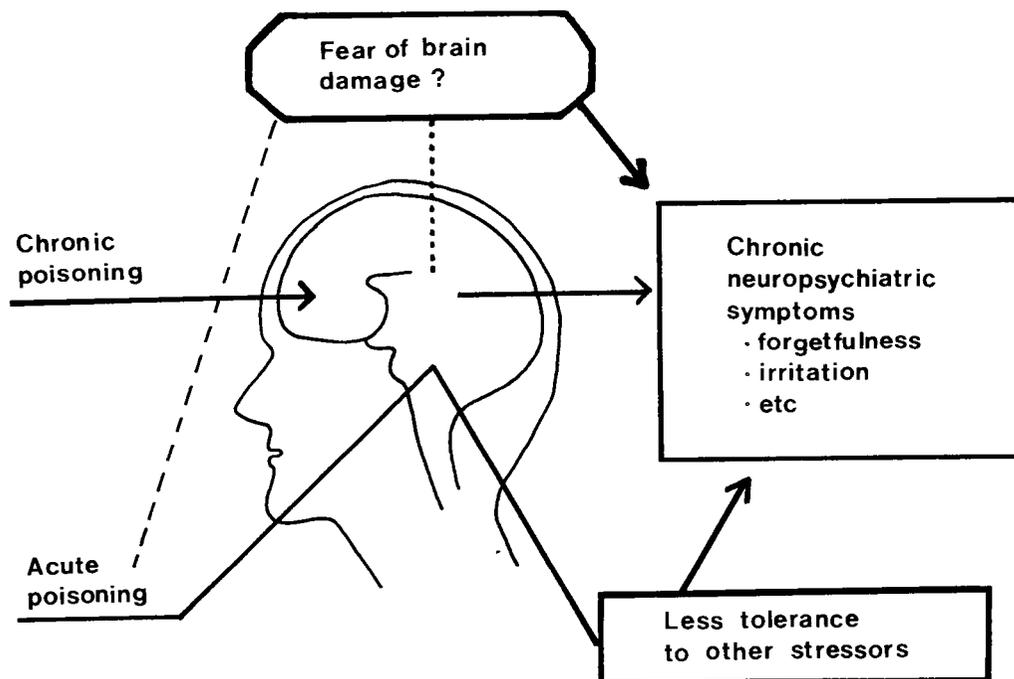


Figure 1. Suggested effects of solvent exposure.

chronic psychoorganic syndrome (6), all could be rehabilitated with insight therapy. Unfortunately, there were several weaknesses in this particular study, and no firm conclusions can be drawn from it.

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