

Neural impairments in a case of Alzheimer's disease

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Abstract	page 1
1. Introduction	page 1
2. The components of the nervous system according to the synapse-state theory	page 1
3. Description of a case of Alzheimer's disease	page 7
4. Loss, retention, and reeducation of response habits	page 8
5. Drop out of a subject	page 14
6. The muscular activity of speech	page 17
7. Evidence of perceptions in speech	page 21
8. Perception revealed in feeling reactions	page 25
9. Concluding discussion	page 24
Acknowledgements	page 28
References	page 29

Abstract

By the synapse-state theory, the activity of the neural system takes place in a network composed of neurons, nodes, and synapses, of altogether 9 different kinds, distributed into 5 layers: sense layer, motor layer, item layer, attention layer, and specious present layer. It is shown how all the symptoms, introspective as well as behavioral, observed over a period of 4 years in a particular case of Alzheimer's disease, the case of the author Iris Murdoch, can be understood to have arisen from the decay, one after the other, of one kind of component, the nodes of the item layer.

1. Introduction

The present study shows how the mental disturbances in evidence in a case of Alzheimer's disease may be understood to arise in consequence of certain particular impairments of the nervous system of the patient. By impairments are understood invalidating changes of individual components of the nervous system as described in the synapse-state theory. The synapse-state theory of mental life was described in Naur (2008). The present study is an extension of that description.

Section 2 is a brief review of the synapse-state theory, with special attention to the components of which the nervous system is composed. Section 3 introduces a particular case of Alzheimer's disease, the case of the author Iris Murdoch, as described in *Iris—A Memoir of Iris Murdoch* by John Bayley (1998). Sections 4 to 8 show how all the patient's patterns of abnormality, as they developed over a period of four years, may be understood to have arisen from particular nodes of the item layer of the patient's nervous system having become inactive one by one. Section 9 is a concluding discussion.

2. The components of the nervous system according to the synapse-state theory

The neural defects that manifest themselves in a case of Alzheimer's disease will here be explained as the breakdown, becoming inactive, of particular components of the neural system, as this system is constituted according to the synapse-state theory of mental life.

2. The components of the nervous system...

The synapse-state theory was first suggested in Naur (2004), Naur (2005), and Naur (2007). In Naur (2008) it was shown how the full range of the phenomena of normal mental life, including the stream of thought, thought objects with their fringes, attention, perception, voluntary movements and speech, etc., may be accounted for by the theory.

The synapse-state theory is grounded in empirical insight into the neural system established during the period 1870 to 1906 by the work of a number of scientists, beginning with Meynert. A brief summary of this insight is presented in the following excerpts of the presentations in James (1890) and Sherrington (1906).

1) *Reflex movements* arise neurally from excitations generated in sense cells that get transmitted through neurons, via neural centres below the hemispheres, into muscles (James, I 14-19).

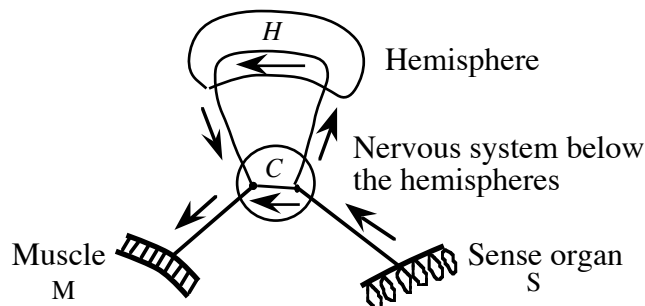


Fig. 1. Neural connections of reflex and voluntary movements

2) *Voluntary movements* arise neurally from excitations generated in sense cells that get transmitted through neurons, become modified and somehow combined with vestiges of past experiences in the cerebral hemispheres, and are then transmitted into muscles (James, I 20-27). Fig. 1, taken from James, shows the neural paths of reflex movements and voluntary movements. It may be noted that James makes a deliberate effort to understand the neural function of the cerebral hemispheres, but admits to fail in his effort (James, I 24-27, 72-78, and II 579-92).

3) All *motor impulses* which leave the cortex pass out from the convolutions about the fissure of Rolando (James, I 31-41).

4) *The mental functions of sight, hearing, smell, and touch*, depend on the neural activity in particular areas of the surface of the brain (James, I 41-65).

5) Neural excitations combine in the neural system by their *summation* (James, I 82).

6) Each living creature is a *bundle of habits*. The phenomena of habit in living beings are due to the plasticity of the organic materials of which their bodies are composed (James, I 104-05).

7) When a *habitual chain of actions* becomes activated, each subaction gets activated from neural excitations originating in sense cells located in the body that get excited from the previous subaction in the chain (James, I 114-15).

8) 'There are *two kinds of knowledge* broadly and practically distinguishable: we may call them respectively *knowledge of acquaintance* and *knowledge-about*' (James, I 221).

9) *We experience thinking*. 'The first fact for us, then, as psychologists, is that thinking of some sort goes on' (James, I 224).

10) 'Every thought tends to be part of a *personal consciousness*' (James, I 225-29).

11) 'Within each personal consciousness *thought is always changing*' (James, I 229-37).

12) 'Within each personal consciousness, *thought is sensibly continuous*'. 'Consciousness, then does not appear to itself chopped up in bits. ... it flows. A "river" or a "stream" are the metaphors by which it is most naturally described' (James, I 237-44).

13) Every thought includes *feelings* (James, I 245-58).

14) Every thought has a *fringe* that makes it aware of relations and objects dimly perceived (James, I 258-71).

2. The components of the nervous system...

15) *'Human thought appears to deal with objects independent of itself; that is, it is cognitive, or possesses the function of knowing.'* (James, I 271-75).

16) *'The object of every thought is neither more nor less than all that the thought thinks, exactly as the thought thinks it.'* *'Whatever things are thought in relation are thought from the outset in a unity, in a single pulse of subjectivity, a single psychosis, feeling, or state of mind.'* (James, I 275-83).

17) *Attention:* *'The thought is always interested more in one part of its object than in another, and welcomes or rejects, or chooses, all the while it thinks'* (James, I 284-89, 402-58).

18) *Voluntary attention* to a part of the thought object can only be sustained for a few seconds at a time. (James, I 420-24).

19) *'The same matters can be thought of in successive portions of the mental stream, and some of these portions can know that they mean the same matters which the other portions meant'*. One might put it otherwise by saying that *'the mind can always intend, and know when it intends, to think of the Same'*. *'The function by which we thus identify a numerically distinct and permanent subject of discourse is called CONCEPTION; and the thoughts which are its vehicles are called concepts'*. *'Each conception thus eternally remains what it is, and never can become another'* (James, I 459-62).

20) *Association in thought:* *'objects once experienced together tend to become associated in the imagination, so that when any one of them is thought of, the others are likely to be thought of also, in the same order of sequence or coexistence as before. This statement we may name the law of mental association by contiguity. ...'* (James, I 561). *'Whatever we name the law, since it expresses merely a phenomenon of mental habit, the most natural way of accounting for it is to conceive it as a result of the laws of habit in the nervous system; ...'* (James, I 561-62). *'The psychological law of association of objects thought of through their previous contiguity in thought or experience would thus be an effect, within the mind, of the physical fact that nerve-currents propagate themselves easiest through those tracts of conduction which have been already most in use.'* (James, I 563).

21) *The specious present:* *'The knowledge of some other part of the stream, past or future, near or remote, is always mixed in with our knowledge of the present thing. ... Objects fade out of consciousness slowly. If the present thought is of A B C D E F G, the next one will be of B C D E F G H, and the one after that of C D E F G H I—the lingerings of the past dropping successively away, and the incomings of the future making up the loss. These lingerings of old objects, these incomings of new, are the germs of remembered recall and expectation, the retrospective and the prospective sense of time.'* (James, I 606-10).

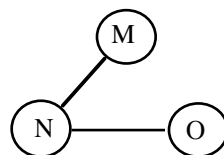


Fig. 2. Retention and recall of the event *n*

22) *Memory* is explained by James in terms of Fig. 2: *'A simple scheme will now make the whole cause of remembered recall plain. Let *n* be a past event; *o* its 'setting' (concomitants, date, self present, warmth and intimacy, etc., etc., as already set forth); and *m* some present thought or fact which may appropriately become the occasion of its recall. Let the nerve-centres, active in the thought of *m*, *n*, and *o*, be represented by M, N, and O, respectively; then the existence of the paths M—N and N—O will be the fact indicated by the phrase 'retention of the event *n* in the memory,' and the excitement of the brain along these paths will be the condition of the event *n*'s actual recall. The retention of *n*, it will be observed, is no mysterious storing up of an 'idea' in an unconscious state. It is not a fact of*

2. The components of the nervous system...

the mental order at all. It is a purely physical phenomenon, a morphological feature, the presence of these 'paths,' namely, in the finest recesses of the brain's tissue. ...' (James, I 655).

23) *'Sensation, then, so long as we take the analytic point of view, differs from Perception only in the extreme simplicity of its object or content. Its function is that of mere acquaintance with a fact. Perception's function, on the other hand, is knowledge about (see above, I 221, cf. point 8 above) a fact; and this knowledge admits of numberless degrees of complication. But in both sensation and perception we perceive the fact as an immediately present outward reality, and this makes them differ from 'thought' and 'conception,' whose objects do not appear present in this immediate physical way.'* *'From the physiological point of view both sensations and perceptions differ from 'thoughts' (in the narrower sense of the word) in the fact that nerve-currents coming in from the periphery are involved in their production. In perception these nerve-currents arouse voluminous associative or reproductive processes in the cortex; but when sensation occurs alone, or with a minimum of perception, the accompanying reproductive processes are at a minimum too. ... (James, II 1-3).*

24) *'Sensations, once experienced, modify the nervous organism, so that copies of them arise again in the mind after the original outward stimulus is gone. No mental copy, however, can arise in the mind, of any kind of sensation which has never been directly excited from without.'* *'Fantasy, or Imagination, are the names given to the faculty of reproducing copies of originals once felt.'* (James, II 44).

25) *The Law of Diffusion:* *'Every impression which impinges on the incoming nerves produces some discharge down the outgoing ones, whether we be aware of it or not. Every possible feeling produces a movement. The movement is a movement of the entire organism, and of each and all its parts'* (James, II 372-82).

26) *'Emotion follows upon the bodily expression.'* *'The bodily changes follow directly the perception of the exciting fact, and our feeling of the same changes as they occur IS the emotion.'* (James, II 449).

27) *'A supply of ideas of the various movements that are possible left in the memory by experiences of their involuntary performance is thus the first prerequisite of the voluntary life.'* (James, II 488).

28) The neurons conducting excitations in reflex arcs are connected by intercellular barriers, called *synapses*. The conductivity for excitations of each synapse changes with the excitations it is subjected to in a plastic way (Sherrington, 15-17). Thus the conductivity states of the synapses embody the habits of the individual.

2. The components of the nervous system...

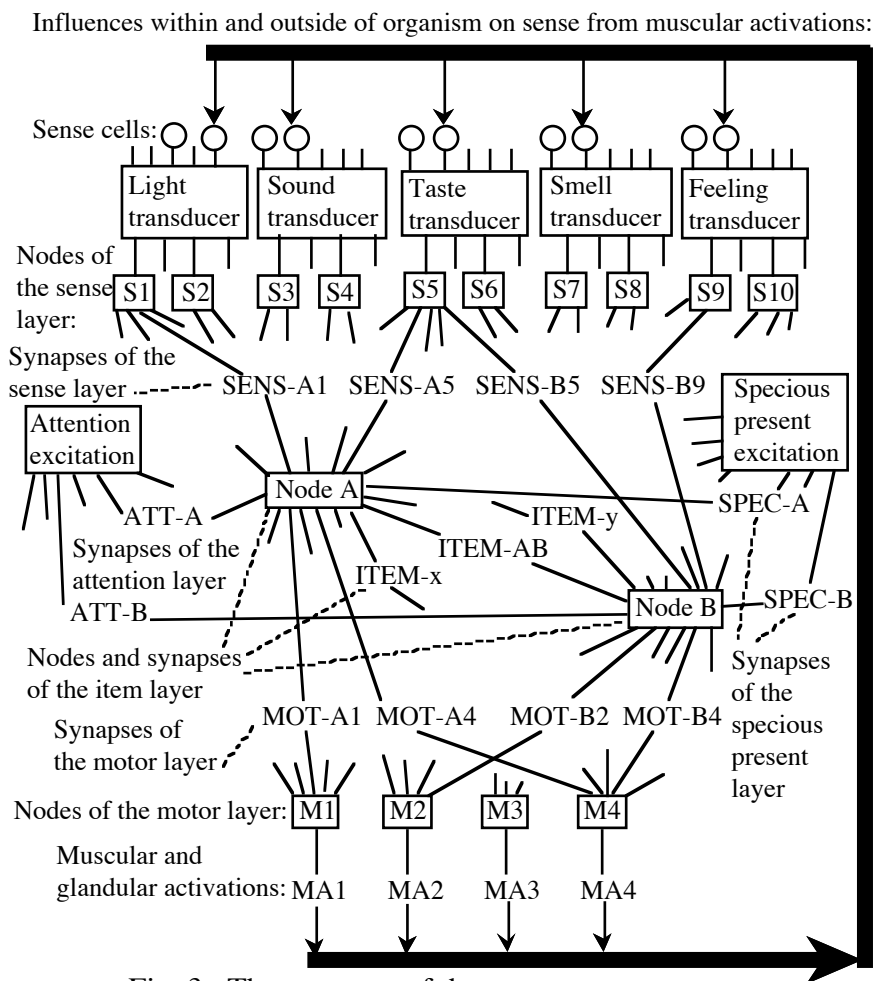


Fig. 3. The structure of the nervous system

The synapse-state theory of mental life combines the insights into the functioning of the neural system stated above. By this theory mental life is embodied in excitations in a neural structure shown in Fig. 3. In this figure the sense cells, the muscles, and the glands, in the organism of the person are shown to be connected in a network having three kinds of components: nodes, neurons, and synapses. The components of the network are distributed into five closely connected layers: sense layer, motor layer, item layer, attention layer, and specious present layer. Each pair of nodes of any of the layers is connected through a path consisting of a neuron, a synapse, and a neuron.

The effects of the activation of the nervous system are muscular contractions, glandular activations, and the experience in the five senses observable by introspection.

The experience is generated by the excitations of the nodes of the sense layer.

Mental life additionally depends on influences into feeling sense cells originating in muscular and glandular activations. These influences are indicated in the figure by the thick arrow.

2. The components of the nervous system...

The typical activity of the nervous system at a particular moment is shown in Fig. 4. The activity consists of excitations, of different strengths, of a large number of components of the network. In the figure the relative strengths of excitation of some of the nodes are indicated by the thickness of the frames drawn around the nodes. The excitations originate in the sense cells and in the attention excitation and the specious present excitation. The excitations are transmitted along the neurons. In the synapses the excitations get modified according to the momentary conductivity of each synapse. In the nodes the excitations arriving from connected neurons are added together and the total excitation forwarded into the remaining neurons. The excitations of the nodes of the sense layer produce the momentary sensual experience of the person. The excitations of the nodes of the motor layer are forwarded into the glands and muscles.

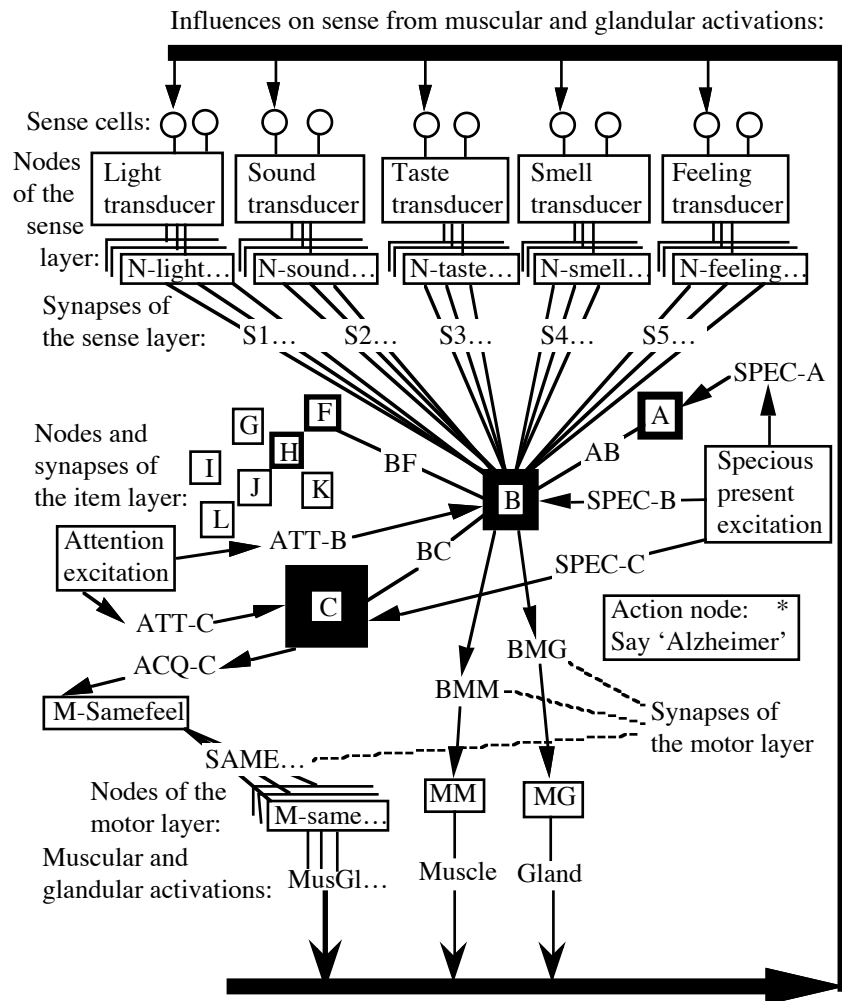


Fig. 4. Momentary excitations of neural system

Sets of nodes, synapses, and neurons, are shown in the figures by means of a notation displayed in Fig. 4 in the connections into node B from the node sets N-light..., N-sound..., N-taste..., N-smell..., and N-feeling..., through the synapse sets S1..., S2..., S3..., S4..., and S5..., and from node M-Samefeel into the node set M-same... through the synapse set SAME....

The education of the nervous system consists in the plastic changes of the conductivities of the synapses that result from their being excited from both of their connected nodes at

2. The components of the nervous system...

the same time. As a result of this education the components of the nervous system get organized into aggregates of five kinds, serving different mental functions: response habit aggregates, subject aggregates, quality aggregates, urge aggregates, and action aggregates. For notational simplicity action aggregates will be distinguished in the figures by a special notation, shown by the example in Fig. 4 (p. 6) of Action node: Say 'Alzheimer'*. This notation is explained in the notes to Fig. 7 (p. 19) below.

It follows from this description that by the synapse-state theory the neural system is made up of components of the following 9 kinds: one kind of neurons, three kinds of nodes (sense, item, and motor), and five kinds of synapses (sense, item, motor, attention, and specious present). All the neurons are physiologically identical, as are the individual nodes of each of the three kinds.

The conductivity for excitations of each synapse of the kinds sense, item, and motor, increases with the excitations the synapse has been subjected to, in a plastic way. Thus at any time each synapse of these kinds is in a certain state of conductivity. The habits of the person at any time are given by the momentary conductivities of these synapses. When a synapse is left unexcited its conductivity will gradually decrease within a time scale of weeks or months for synapses of the sense and motor layers, of years for synapses of the item layer.

The attention and specious present synapses are non-conductive except for those short periods of time, of the order of seconds for attention, and of the order of hours for specious present, when as a result of a strong excitation of the connected node of the item layer the synapse will transmit a strong impulse into that node.

In the present analysis of a case of Alzheimer's disease it is assumed that the impairments giving rise to the disease are destructions of single components of the nervous system of a particular kind. In other words, the analysis will explore the hypothesis that Alzheimer's disease arises from a progressive decay of one particular kind of components of the neural system, whereby these components get inactive one by one.

In passing it is noted that certain kinds of mental diseases have already been explained in terms of defect functioning of components of the neural system in Naur (2009) chapters 6 and 7.

3. Description of a case of Alzheimer's disease

As the empirical source of information on a case of Alzheimer's disease shall here be used John Bayley: *Iris—A Memoir of Iris Murdoch*, 1998. The choice and use of this source will here be justified as follows.

First, as the life companion and spouse of the author Iris Murdoch from 1954 until she died in 1999, John Bayley has been in a unique position to observe the manifestations of her Alzheimer's disease. Second, being himself a writer of several novels, John Bayley is highly qualified as a reporter of his observations. Third, the attitude adopted by John Bayley in his presentation has been singularly felicitous to the present analysis, by being practically purely empirical, resulting in a wealth of concrete observations, while refraining almost entirely from psychologizing interpretations. Such interpretations are found only in a few places, thus on p. 34: 'But Iris remains her old self in many ways. The power of concentration has gone, along with the ability to form coherent sentences, and to remember where she is, or has been. She does not know she has written twenty-seven remarkable novels, as well as her books on philosophy ...'. These faculty-psychological interpretations, which are grounded in notions of faculties of concentration, of forming coherent sentences, of remembering, and of knowing, are here found misleading and useless. It is noted in passing that faculty-psychology was rejected as misguided already by William James in his *Principles of Psychology* from 1890.

3. Description of a case of Alzheimer's disease...

As a very general observation: Alzheimer's disease develops in stages, over several years. John Bailey's first observations of Iris Murdoch's defective reactions date from 1994. His last report is dated 25 December 1997. On page 165 he writes:

'15 April 1997 — Moving from stage to stage. How many are there? How many will there be?'

The development by stages supports the suggestion made above, that in terms of the synapse-state theory the disease is a matter of the decay, becoming inactive, one by one, of one kind of components of the nervous system.

4. Loss, retention, and reeducation of response habits

In the present first step of the analysis of the Iris Murdoch-case, the first concrete manifestation of the disease noticed as such by John Bayley, Iris Murdoch's public performance fiasco at a meeting in 1994, shall first be considered in some detail. John Bayley writes (p. 147-48):

'In 1994 we were invited by the University of the Negev in Israel, to take part in an international gathering ... Iris asked not to give a paper, but said she would rather take part in a discussion in which she would answer questions on her novels or philosophical writings. She had often done this before, and it was always a success, because while never holding the floor she had the knack of taking seriously anything that was put forward by the questioner, and investigating its potential in a friendly and sympathetic way which was both flattering and rewarding for the audience.

This time it all went wrong. The Chairman was sympathetic, but soon baffled and made uncomfortable by Iris's inability to bring out the words she seemed to want. Her delivery had always been slow and thoughtful and a little hesitant, and at first I was not perturbed, sure that she would recover in a few minutes as she got the feel of the gathering. It was hard to say how conscious she was of her own difficulty, but the effect soon became paralysing, for the listener as well as for herself. The audience was polite, but the liveliness and curiosity in their faces was gone: they began to look concerned and embarrassed. Israelis are straightforward in their reactions. Several people simply got up and left the conference room.

I thought she would tell me afterwards how awful it had been, and that for some reason she simply hadn't felt up to it, but that did not happen. She seemed unaware and to shrug the incident off, together with my cautious solicitude: I tried to avoid giving any impression that a fiasco had taken place. The chairman and one or two others came up to her afterwards and she talked to them and laughed in her natural way. One asked about her last novel, *The Green Knight*, and produced a copy for her to sign.

In order to determine the neural defect manifest in this incident, consider first the neural components and the activity of Iris Murdoch's nervous system that habitually have been contributing in the past when she has been participating successfully in discussions of her works.

4. Loss, retention, and reeducation of response habits...

The principal components are shown in Fig. 5. Centrally there is a number, perhaps a few hundred, of nodes of the item layer, each such node embodying a particular topic relevant to discussing Iris Murdoch's literary works, such as characters of her novels,

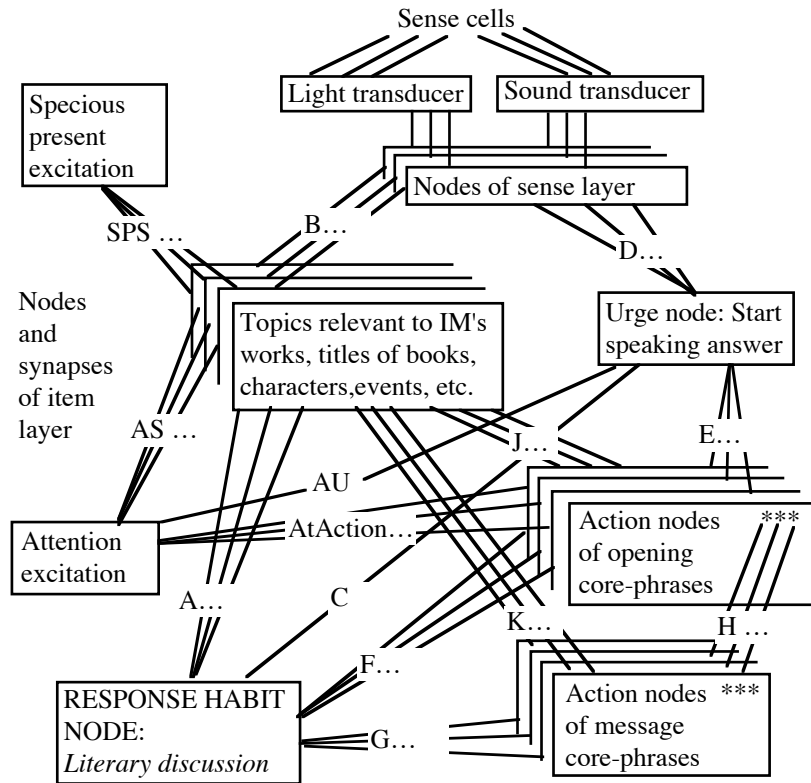


Fig. 5. Neural components excited in literary discussion

incidents described in the novels, etc. While she is actively participating in the discussion, each of these nodes will receive steady preperception excitation from the response habit node *Literary discussion*, through the conductive synapses shown as A... When during the discussion one of these topics is mentioned by a questioner, the corresponding topic node will receive excitation originating in sound sense cells and passing through the sound transducer, nodes of the sense layer, and conductive synapses of the sense layer shown as B.... When combined in summation with the preperception excitation from the response habit node transmitted through one of the conductive synapses shown as A..., the attention and specious present synapses of the particular phrase node shown as AS... and SPS... will become excited. By this mechanism the particular nodes of topics that have been mentioned will retain excitation during the discussion and the minutes and hours of the following specious present. There will therefore be excitations through some of the synapses J... and K... that will be added to other excitations of the Action nodes of opening and message core-phrases, and so will influence what is spoken by Iris Murdoch as contributions to the discussion and perhaps afterwards.

Iris Murdoch's active responses to questions in the situation are initiated by excitations of the urge node Start speaking answer. This node will receive steady preperception excitation from the response habit node *Literary discussion*, through the conductive synapse shown as C. When it receives further excitations originating in certain sensations of sounds and sights indicating the termination of a pronouncement of a questioner in the discussion, and passing through the light and sound transducers, nodes of the sense layer, and the conductive synapses D ..., the urge node will excite its attention synapse AU, and

4. Loss, retention, and reeducation of response habits...

so through the conductive synapses E... will transmit excitation into the first node of all the action aggregates embodying core-phrases that have habitually opened an answer given by Iris Murdoch in discussions of her work. These first nodes will already have received preactivation excitation from *Literary discussion* through the conductive synapses F.... Some of them may also have received excitations from the excited node of topics relevant to IM's works through the conductive synapses J.... That one of these nodes that by summation of excitations in this way becomes most strongly excited will excite its attention synapse, being one of the synapses shown as AtAction..., and will thus start the action of speech embodied in the node. Once started in this way the speech action will continue into other action nodes of other message core-phrases, first excited at the end of the opening core-phrase through one of the synapses H.... The action aggregates of opening and message core-phrases embody Iris Murdoch's habitual answers in the situation, including their manner of delivery, said by John Bayley to have been always 'slow and thoughtful and a little hesitant'.

In Negev in 1994 this pattern of reactions failed to happen, in two ways. First, Iris Murdoch did not speak at the moments she was invited to, and, second, a few minutes later she was observed to have failed to register anything about what had taken place during the discussion session. These failures might have been caused by a defect in a number of the components shown in the figure, such as a wholesale breakdown of all the nodes of the item layer embodying the topics of Iris Murdoch's works. However, the failures may be explained entirely merely by the failure of one single node of the item layer: the response habit node *Literary discussion* in Fig. 5 (p. 9). If this node fails, the perception, that is the excitation of the nodes of topics, will also fail. Iris Murdoch will fail to perceive the sounds spoken in questions as phrases of the language. She will experience them as being of an unfamiliar language, and will thus fail to experience their reference to topics of her work and the way they invite her to give answers. (Failure of the urge node *Start speaking answer* would explain her failure to start speaking, but would not explain her failure to register the happening).

In summary, this analysis suggests very strongly that Iris Murdoch's failure at the session in Negev in 1994 was caused by the failure of one node of the item layer, the response habit node *Literary discussion* in Fig. 5 (p. 9).

This first determination of one kind of effect of Alzheimer's disease as being the loss of a response habit node is amplified in several other of the manifestations of the disease described by John Bayley. These descriptions further indicate that in the Alzheimer patient, in a situation in which the response habit node that has been lost, another response habit aggregate may be established by education.

As evidence of this, consider first John Bayley's description of the loss of wake up response habits and the subsequent education of another set in its place, p. 165, written 15 April 1997:

'I used to dread her moments of waking, because the situation seemed to strike her then in full force, at least for a minute or two. Reassuring noises, so far as possible, and then she would go back to sleep, and I would sit beside her reading or typing. The sound of it seemed to help as reassurance. Iris's greed for sleep had something desperate about it, and yet she slept, and still sleeps, so easily and so long in the morning that it was a great mutual comfort. ...

But thank goodness the stage of that old despair on waking seems to be over. Now she makes a soft chuckling sound and looks at me like the Teletubby baby in the blue sky on TV. No anxious queries. We exchange a few of the old nonsense words before

4. Loss, retention, and reeducation of response habits...

she goes to sleep again. As the condition gets worse it also gets better. It seems to compensate each new impoverishment. Should be more thankful for that.

This shows how the wake up response habits that have disappeared, at first have been taken over by reflex reactions. The more prominent reflex reactions are such that ward off immediate threats. They will automatically be accompanied by feelings of fear. Then later, by the passing of many mornings, the reflex reactions get educated into a new set of wake up response habits. These wake up response habits are described by John Bayley on p. 57:

'... As I work in bed early in the morning, typing on my old portable with Iris quietly asleep beside me, her presence as she now is seems as it always was, and as it always should be. I know she must once have been different, but I have no true memory of a different person.

Waking up for a peaceful second or two she looks vaguely at the 'Tropical Olivetti' lying on my knees, cushioned by one of her jerseys. Not long ago, when I asked if it disturbed her, she said she liked to hear that funny noise in the morning. She must be used to it, although a couple of years ago she would have been getting up herself at this time—seven o'clock—and preparing to start her own day. Nowadays she lies quietly asleep, sometimes giving a little grunt or murmur, often sleeping well past nine, when I rouse and dress her. This ability to sleep like a cat, at all hours of the day and night, must be one of the great blessings that sometimes go with Alzheimer's, converse of the anxiety state that comes on in wakefulness and finds worried words like "When are we leaving?"

Dressing most days is a reasonably happy and comic business. I am myself still far from sure which way round her underpants are supposed to go: we usually decide between us that it doesn't matter. Trousers are simpler: hers have a grubby white label on the inside at the back. ...

It seems normal that the old routines of washing and dressing have vanished as if they too had never existed.'

A case of education of an entirely new set of response habits at a time when the Alzheimer disease has been developing for several years is described by John Bayley, first on p. 157, of 1. January 1997:

'... Pondered such matters while making Iris her drink, after the Archbishop's speech. Important to make a routine of this. Around twelve o'clock or a little before. The drink itself slightly dishonest: a little drop of white wine, a dash of angostura bitters, orangeade, a good deal of water. Iris likes it, and it has a soothing effect, making her sit watching TV for longer periods. Otherwise she is apt to get up and stand with her back to the TV, fiddling incessantly with her small *objects trouvés*—twigs and pebbles, bits of dirt, scraps of silver foil, even dead worms rescued from the pavement on our short walks. She also puts water—sometimes her drink—on the potted plants by the window, which are now wilting under the treatment.'

Again on p. 173-74, of 4 June 1997:

'Nightmare recollection of a day in the hot summer last year, just before or after our swim in the Thames. ... The trouble was, or seemed to be, my rage over the indoor plants. There are several of these along the drawing-room window-sill—cyclamen, spider-plant, tigerplant as we called a spotty one—to which I had become rather attached. I cared for them and watered them at the right intervals. Unfortunately they had also entered the orbit of Iris's obsession with her small objects, things she has picked up in the street and brought into the house. She began to water them compulsively. I was continually finding her with a jug in her hand,

4. Loss, retention, and reeducation of response habits...

and the window-sill and the floor below it slopping over with stagnant water. I urged her repeatedly not to do it, pointing out—which was certainly true—that the plants, the cyclamen in particular, were beginning to wilt and die under this treatment. She seemed to grasp the point, but I soon found her again with a jug or glass in her hand, pouring her water.'

While the wake up habits are completely changed, other response habits continue to function unchanged as in previous life. John Bayley writes on p. 58:

'At the same time Iris's social reflexes are in a weird way still very much in place. If someone comes to the door — the postman, the man to read the gas meter — and I am for the moment occupied elsewhere, she receives him with her social smile, and calls for me in those unhurried slightly "gracious" tones which married couples automatically use on each other in the presence of a stranger. "Oh I think it is the man who has come to read the meter, darling." In the same way she deals instinctively with more complex social situations; seeming to follow the conversation and smiling, prepared to bridge a silence by asking a question. Usually the same question: "Where do you come from?" or "What are you doing now?" — questions that get repeated many times in the course of a social event.'

The alternation between behavior according to new and old response habits is described by John Bayley in an account of how it happens at a special occasion, p. 168 from 15 April 1997:

'Kind friends up our street are giving a Sunday morning drinks party. I used to enjoy the quiet of Sunday mornings, the Sunday paper, leisurely breakfast with Iris working upstairs, absence of morning anxiety about what I had to do that day. In those days I should have made some excuse, Iris acquiescing. She wouldn't have minded going, but knew I wouldn't want to. Now it offers a welcome distraction. I say nothing about it until 11. If I did she would panic, demand why I hadn't told her sooner. She does not distinguish now between what she wants to do and what is happening.

"Are we going to London?"

"No, just up the street. You'll know them when we get there. They're very nice. You'll like it."

I know this is true, but it produces a "trouser grimace" as I now call it in my mind. Every evening we have the battle of the trousers. She wants to go to bed in them, and everything else she is wearing too. My resistance to this is half-hearted, compared with the determination she shows on the issue. Sometimes I win, more or less dragging them off. Iris gives up the struggle, but produces a frightful grimace, an expression wholly new and different from anything her face ever did in the past. It always unnerves me, and is becoming more frequent in other situations.

Iris Murdoch's resistance to undressing would be her reflex reactions that occur without having been educated. John Bayley continues on p. 168:

Not that I care about her trousers. Our habits have never been exactly hygienic; and yet distinguishing day from night now seems vital to our saving routines. Twice in the day, at ten in the morning and five in the evening, panic and emptiness descend, not because there is something we have to do but because there isn't. Routine has no suggestions to make. All I can do then is to promise the next thing soon. A drink. Lunch, or supper.

Iris's fear of other people if I'm not there is so piteous that I cannot bring myself to arrange for carers to "keep her company", or to take her to the age therapy unit. All

4. Loss, retention, and reeducation of response habits...

that will have to come. Meanwhile I am ruthless about getting her ready for the party, confident that she will enjoy it when she gets there, as they used to tell us in childhood.

She does. It is a nice party. I marvel, as I have often done before, at the way in which guests enjoy being guests. Standing opposite someone and keeping going, holding eye contact in the same practised precarious way that one holds glass and canapé. Like a navel battle in Nelson's time: ship to ship, yardarm to yardarm. Sometimes another ship looms up through the noise of battle. Should I switch targets, or redouble broadsides against the present opponent? There is something remorseless about the concentration required. No one wants to be drifting aimlessly through the battle, guns silent, disengaged

The extraordinary thing is that Iris can, as it were, serve her guns and return fire just like everybody else. I shouldn't have brought her if I hadn't known it would be so. Her face becomes animated — no trace of trouser grimace; she is playing her part just like the rest of us. Mustn't this be good therapy? I should like to think so, but exercise in that sense would imply improvement, recovery. This happy distraction can only be for the moment. I close cautiously on the stern (still automatically Nelsonian) of the guest who is talking to Iris. He is giving a tremendous impression of being good at his work, and happy at it. Half listening, while at the same time engaging my own opponent closely, I overhear a lively account of the way things are done in an Insurance Adjustment office. Smiling Iris listens closely — her attention must be flattering. Then I hear her say: "What do you do?" From the face opposite her it is evident that the question has been repeated several times in the last few minutes. Undiscouraged he begins all over again. ...

Coming up to me the hostess says: "Isn't Iris wonderful?" She sounds surprised, perhaps thankful that there is no squeaking or gibbering going on. I am conscious of a base sense of annoyance, even exasperation. People who see Iris on such occasions assume there must be nothing much to worry about. Suppose I were to say to our hostess, "You should see how things are at home." Thank goodness one cannot or does not say things like that at parties.

When we get home I try to keep Iris interested in the party, saying how much people had liked seeing her. In retrospect the party does seem to have been a happy time, I am already looking back on it with nostalgia. But it is not remembered. Iris begins to say anxiously, "When do we go?" I wonder how many times she asked the insurance man what it was that he did.'

Iris Murdoch has also retained several other sets of response habits, such as those involved when signing books here (John Bayley, p. 34):

'... If an admirer or friend asks her to sign a copy of one of her novels she looks at it with pleasure and surprise before laboriously writing her name and, if she can, theirs. "For Georgina Smith. For Dear Reggie ..." It takes her some time, but the letters are still formed with care, and resemble, in a surreal way, her old handwriting. She is always anxious to oblige. And the old gentleness remains.'

Other sets of response habits retained by Iris Murdoch are those involved in swimming (John Bayley, p. 34):

'Once in the water Iris cheers up a bit. It is almost too warm, hardly refreshing. But its old brown slow-flowing deliciousness remains, and we smile happily at each other as we paddle quietly to and fro. ... Iris still swims as naturally as a fish. Since we first entered the water here together, forty-four years ago now, we have swum in the sea, in lakes and rivers, pools and ponds, whenever we could and wherever we happened to be'.

4. Loss, retention, and reeducation of response habits...

Certain response habit aggregates remained intact up to the last time reported upon. One example is from John Bailey's very latest report, p. 186:

'25 December 1997 — And it's Christmas morning. And we are doing all the usual things. Routine is a substitute for memory. Iris is not asking the usual anxious questions — "Where are we? What are we doing? Who is coming?" ...

Our route on Christmas morning is always the same. We have been doing this for years. As we pass their spectral houses I now utter a little bit of patter like a guide. Henry James, Robert Browning, T.S. Eliot. On former mornings like these we used to gaze up at their windows, talk a bit about them ... Now I just mention the names. Does Iris remember them? She smiles a little. They are still familiar, those names, as familiar as this unique morning silence. ...

As we walk round and admire I tell Iris that my mother assured me that if I looked hard enough over the railings, into the private dells where the bluebells and daffodils come up in spring, I might see fairies, perhaps even Peter Pan himself. ... Iris is listening, which she rarely does, and smiling too.'

5. Drop out of a subject

The earliest symptom of Iris Murdoch's Alzheimer disease observed by John Bayley, in 1994, is described on p. 148:

... It was at that moment I remembered being surprised at her telling me, several months before, that she was in trouble over her current novel, the one that appeared the following year as *Jackson's Dilemma*. Often before, if I asked her, or sometimes if I didn't, she would complain she was stuck, she couldn't get on with the current novel, and in any case that it was no good at all. I used to make reassuring noises, knowing this would pass, and that in a few days she would suddenly seize pencil and paper while we sat eating or drinking at the kitchen table and write something down. I would say "Better?" and she would reply "I think so."

But this time it was quite different. "It's this man Jackson," she had said to me one day with a sort of worried detachment. "I can't make out who he is, or what he's doing." I was interested, because she hardly ever spoke of the people in a novel she was writing. "Perhaps he'll turn out to be a woman," I said. Iris was always indulgent to a joke from me, even a feeble one, but now she looked serious, even solemn, and puzzled. "I don't think he's been born yet," she said. ... The mysteriousness of Iris's remark seemed to me at the time quite normal. "Don't worry — I expect he'll be born any day now," I said absently, but she continued to look worried and upset. "I shan't do it, and shall never do another," she said, still in that quiet detached tone.'

Spoken by Iris Murdoch in the middle of writing a novel including a main character called Jackson, these pronouncements are very telling. They clearly cannot be assumed to express just passing sentiments but must be assumed to express something that has been pondered repeatedly by the author at the time before they were spoken.

In order to make neural sense of the pronouncements, it will be necessary to look closely into the neural processes that must be assumed to have entered into Iris Murdoch's writing of the novel *Jackson's Dilemma*. Like any extended writing, this activity will have alternated between phases of planning and phases of performing the muscular activity of writing.

During the phases of planning, the author by pondering will establish the characters and events presented in her novel and the sequence in which the descriptions of the characters and events will be presented. The process of pondering consists in giving attention to several issues, such as characters, and/or events, and/or sequences, in quick succession, within the same specious present. This process is embodied in strong, simultaneous

5. Drop out of a subject...

excitations of the nodes embodying the characters, and/or events, and/or sequences. As a result of the strong excitations, the synapse connecting each pair of these nodes will have its conductivity increased, in a plastic manner. Thus by the process of pondering *the characters, events, and sequences, will become embodied in the nervous system in the form of the conductivities of the synapses connecting pairs of nodes of the relevant subject, quality, and action aggregates.*

The action aggregates mentioned here will be such that embody the action of writing relevant core-phrases. They are found, for the most part, in the large arsenal of writing-action aggregates in the writer's nervous system that forms the basis of the author's activity as a writer.

Nodes and synapses of the item layer

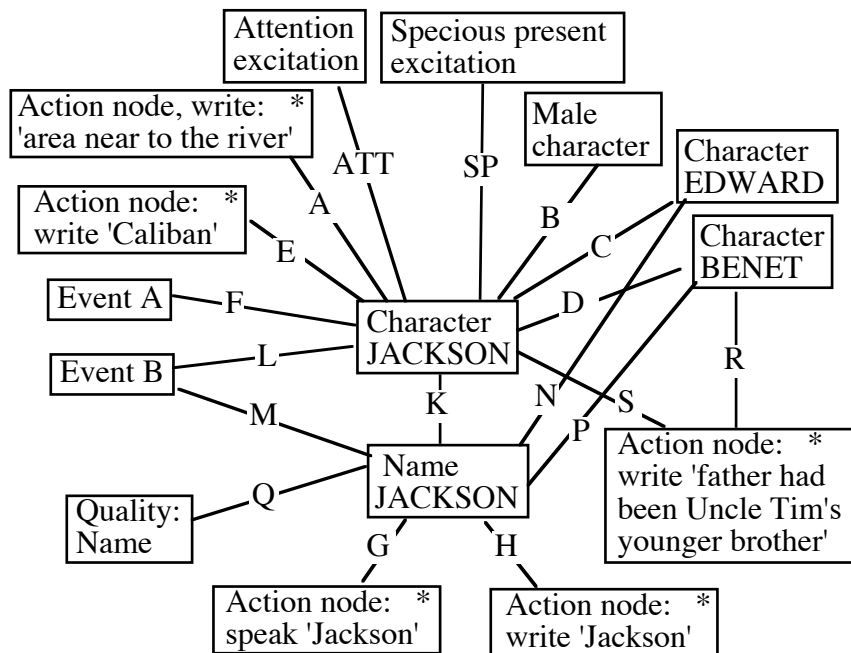


Fig. 6. Iris Murdoch's loss of 'this man Jackson'

As shown in Fig. 6, a character such as 'this man Jackson' will be embodied by four nodes: Character JACKSON, Name JACKSON, Action node: speak 'Jackson', and Action node: write 'Jackson'. During the phases of planning the synapses through which these nodes are connected to a large number of other nodes embodying the items with which the character Jackson is associated in the novel, such as other characters, places, and events, will be made conductive. Some of these synapses are shown in the figure as A, B, C, D, E, F, L, M, N, P, and Q,

Of these four nodes only Character JACKSON has been necessary in the planning of the plot of the novel. By this planning the synapses connecting it to other nodes embodying items of the novel, such as A, B, C, D, E, and F, have become conductive.

On the other hand, the aggregate consisting of the node Name JACKSON, the two Action nodes speak 'Jackson' and write 'Jackson', and the connecting synapses G and H, will have been established as part of Iris Murdoch's education, long before the planning of the novel.

The assigning of the name *Jackson* to the character, embodied in the conductivity of synapse K, must have happened at some specific moment of pondering during the planning of the novel. It will here be assumed that this choice of the name was made late in the

5. Drop out of a subject...

planning of the novel, and that the character eventually named Jackson has first been introduced in the author's plan indirectly in terms of certain relations, for example 'the male character met by Benet in the area near the river in the event A'. This identity will then have been embodied in the conductivities of the synapses A, B, D, and F. The participation of this character in other events, such as Event B, may have been established before the choice of the name Jackson. If so this participation will have been embodied in the conductivity of the synapse L, not in the synapse M connected to Name JACKSON.

That the choice of the name Jackson was late in the planning of the novel gets some confirmation in the fact that the name and character *Jackson* is not introduced in the text until briefly in the last line of Chapter One on page 48 of the book, and is not presented in detail before page 84 in Chapter Three. At that stage of the tale about 25 other characters have been introduced.

While Iris Murdoch's neural system was still functioning normally, at a time when the author had not yet decided on the name Jackson for the character, the author's 'thinking of the character Jackson' was embodied in excitation of the node Character JACKSON, resulting from, first, the summation, in the node, of excitations coming through such synapses as B, C, and D, and second, the additional excitation resulting from the activation of the attention and specious present synapses, ATT and SP, of the node.

When finally the author had chosen the name Jackson for the character those synapses connecting to the node Name JACKSON would become conductive that connected to nodes that were excited at a moment when the node Name JACKSON was also excited. This would mostly be at such moments when the author was actually performing the action of writing the name Jackson into her manuscript. This might for example be the case for Character EDWARD and Character BENET, resulting in making the synapses N and P conductive. On the other hand, a number of other synapses connecting to Name JACKSON from other nodes involved in the planning, such as M, would be left non-conductive.

Consider now the state of Iris Murdoch's nervous system at the time of her saying to John Bayley: "It's this man Jackson. — I can't make out who he is, or what he's doing. — I don't think he's been born yet." These statements suggest that while the identity of the character with the name Jackson was embodied in Iris Murdoch's neural system, hardly any of the associated relations to other themes of the story was intact. The most plausible explanation of this state of affairs is that at the time *the node Character JACKSON, after having earlier become connected by conductive synapses to many nodes, had now become inactive*. This would explain that the excitation of the node Name JACKSON fails to excite a number of nodes, connected to Character JACKSON by conductive synapses. Hence the author's saying 'I can't make out who he is, or what he's doing'.

We have to consider how this understanding accords with the later events related to Iris Murdoch's novel. John Bayley writes:

[P. 151] Jackson had been finished at last, and named *Jackson's Dilemma*. ...

[P. 151] *Jackson's Dilemma* came out and got exceptionally good reviews. I read these reviews to Iris, a thing I had never done before because she had never before wanted to listen. Now she listened politely but without understanding.

The irony did not bother her or even occur to her. Nor did I tell her that there had also been a number of letters about the reviews, pointing out small errors and inconsistencies in the narrative of *Jackson's Dilemma*. ...

5. Drop out of a subject...

[P. 153] Jackson came out in 1995: Iris's condition has deteriorated steadily over the past eighteen months.'

The plausible explanation of these later events is that Iris Murdoch simply invented a new character under the name Jackson. This plausibility finds some support in the fact that the text of *Jackson's Dilemma* has inconsistencies that may be understood most plausibly as being the results of the author's reinvention of parts of the plot. Thus in Chapter Five we are told that Marian Berran meets Cantor Ravnevik. In Chapter Ten we learn that Marian and Cantor have married. In Chapter Thirteen we learn that 'Marian Bjerke was also about to have a baby', the name Bjerke occurring here for the first time.

Another inconsistency: in Chapter One Edward Lannion is explained to have become acquainted with the inhabitants of Penndean, in particular Benet, only after the death of Benet's uncle Tim. In Chapter Six we are told that, playing billiard with Edward, Benet says: 'Do you remember how we used to play "Freda", running round and round this table, you and me and Uncle Tim and the children -'.

As the conclusion of this discussion of Iris Murdoch's reaction concerning the character Jackson early in 1994, this reaction may be understood completely to have arisen from the destruction, getting inactive, of one single node of the item layer of her nervous system, the node here denoted Character JACKSON, at a time when this node had already become connected by conductive synapses to a number of other nodes entering into her plan for the novel *Jackson's Dilemma*.

6. The muscular activity of speech

In the present step of the analysis of the Alzheimer victim's responses we shall concentrate on the speech sounds produced. John Bayley presents the following literal quotations of Iris Murdoch's speech as it was at the advanced stage of her Alzheimer disease in 1997:

P. 162:

'30 March 1997 '

P. 162: '... I make a savage comment today about the grimness of our outlook. Iris looks relieved and intelligent. She says: "But I love you."

*

Iris surprised me when the radio was on and we were having lunch — toast, cheese, beetroot and lettuce salad — by asking, "Why does he keep saying "education?"" She sounded anxious. Anxiety and agitation are so much a part of her speech now, like the unending query, "When are we going?" ... I try to say something about the importance of education, and everyone getting enough of it. Iris still looks anxious. "Do they read books?" ...'

P. 163: "When are we going?" — "I'll tell you when we go." — Iris always responds to a jokey tone. But it is sometimes hard to maintain. Violent irritation possesses me and I shout out before I can stop myself, "Don't keep asking me when we are going!"

P. 165 '15 April 1997'

P. 166: '... At the station she keeps repeating, "Why didn't you tell me we were going?' I had told her many many times. ...'

P. 168: 'Kind friends up our street are giving a Sunday morning drinks party. ... "Are we going to London?" — "No, just up the street ..."'

6. The muscular activity of speech...

P. 169: '... I overhear a lively account of the way things are done in an Insurance Adjustment office. Smiling Iris listens closely—her attention must be flattering. Then I hear her say: "What do you do?" From the face opposite her it is evident that the question has been repeated several times in the last few minutes.'

P. 170: 'When we get home I try to keep Iris interested in the party, saying how much people had liked seeing her. In retrospect the party does seem to have been a happy time, I am already looking back on it with nostalgia. But it is not remembered. Iris begins to say anxiously, "When do we go?" I wonder how many times she asked the insurance man what it was that he did.'

P. 175 '20 November 1997'

P. 176: '... Peter puts us on the bus for Oxford. Sink back thankfully. Nearly home. Bus cruises steadily on through the dark, seeming to shrug off the rush-hour traffic on either side of it. The few passengers are asleep. But we have no sooner started than Iris is jumping up and down in agitation. Where are we going? Where is the bus taking us? She won't sit still but rushes to the front and looks out anxiously ahead. I manage to get her sitting down. I say: "We are going back to Oxford. Back home." "No! No home. Why travelling like this. He doesn't know." Before I can stop her she is speaking agitatedly to the bus driver. She has caught hold of one of the bags, which begins to spill things on the gangways. I pick them up, push her into a seat opposite a sleeping woman. I apologize to the driver, who remains ominously silent. When I get back the woman, a nice-looking person, is awake, and distraught, desperately trying to regain the handbag and other possessions which had been on the seat beside her. I take them from Iris and put them back, apologising again in a whisper. Iris says, "So sorry", gives the woman her beautiful smile.'

P. 177: 'Jim washed and cut her hair in Lanzarote; Audi gave her a shower and a bath. She said to Audi as they stood together in the shower, "I see an angel. I think it's you." ...'

P. 179: 'Twice Iris has said to Peter Conradi that she feels now that she is "sailing into the darkness". It was when he asked her, gently, about her writing.'

Undated observations of features of Iris Murdoch's muscular speech activity are further given by John Bayley on p. 43:

'... An Alzheimer sufferer begins many sentences, usually with an anxious repetitive query, but they remain unfinished, the want unexpressed. Usually it is predictable and easily satisfied, but Iris produces every day many such queries, involving "you know, that person", or simply "that", which take time and effort to unravel. Often they remain totally enigmatic, related to some unidentifiable man or woman in the past who has swum up to the surface of her mind as if encountered yesterday.'

6. The muscular activity of speech...

In order to make neural sense of these observations, consider the neural mechanism by which speech is produced, as shown by a concrete example in Fig. 7. This shows the details of the action aggregates in Iris Murdoch's nervous system that get activated in speaking the phrase 'I see an angel'. The phrase will be spoken as the core-phrase 'I see' followed by the core-phrase 'an angel'. Conductive synapses are shown in the figure by lower case letters: c, d, etc., and conductive synapse sets are shown as e..., f..., etc.

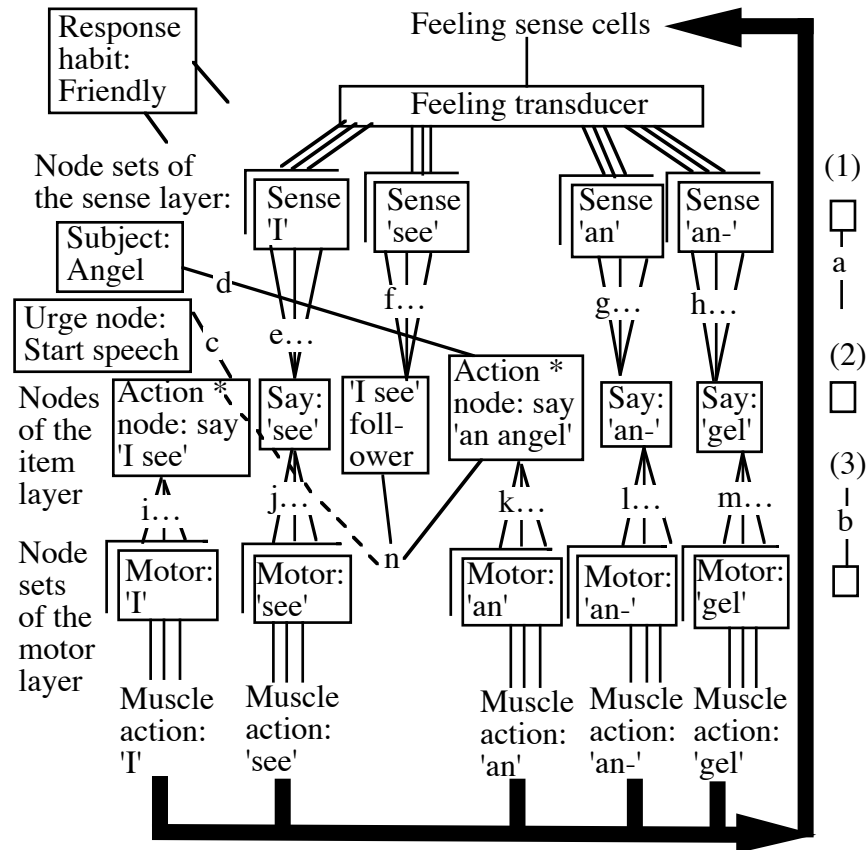


Fig. 7. Neural excitations and sensations in saying 'I see an angel'

All the nodes of the item layer shown will receive excitation from such response habit nodes that are excited in the situation. This is suggested by just one such node, Friendly, where for simplicity of the figure the connections through neurons and synapses to the remaining nodes have been omitted.

The activity of speech starts when the Action node: say 'I see' is excited strongly from the Urge node: Start speech, through the synapse c. The excitations will then proceed step by step, alternating between excitation of a set of nodes in the motor layer and a set of nodes in the sense layer, the excitations being directed by the nodes of the item layer. These excitations happen in the following order: Motor: 'I', Sense 'I', Motor: 'see', Sense 'see'. The excitation of the node set Sense 'see' transmits excitations through the synapse set f... into the node 'I see' follower. This node will through conductive synapses transmit excitations into such other action nodes that embody core phrases that habitually have been spoken immediately after the core-phrase 'I see'. Thus the Action node: say 'an angel' will become excited through the synapse n. That action node will in the situation have been preexcited from other nodes, such as Subject: Angel through synapse d. By the summation of the excitations into Action node: say 'an angel' the continued muscular speech activity will be set going.

6. The muscular activity of speech...

Note that for notational simplicity, in other figures of the neural components the action aggregates are shown merely as the first Action node, marked with *. The neuron emerging from the follower node, shown in the figure as the neuron into synapse n, is then shown as emerging from the * as indicated dashed in Fig. 7 (p. 19).

The neural network shown in Fig. 7 is composed of components of the following three kinds, indicated to the right in the figure:

(1) A node of the sense layer, together with its neural connection through a conductive synapse of the sense layer, a, into a node of the item layer. Of this kind there will as many as there are nodes of the sense layer contributing to the particular speech activity considered, of the order of a hundred one might guess.

(2) One of six nodes of the item layer guiding the particular speech activity.

(3) A node of the motor layer, together with its neural connection through a synapse from a node of the item layer, b. Of this kind there will as many as there are nodes of the motor layer contributing to the particular speech activity considered, of the order of twenty one might guess.

As the basis for determining the neural impairments which are the likely causes of the impairments of Iris Murdoch's speech performance, consider the speech performance disturbance that would result as the consequence of a defect in each of these three kinds of components.

- A defect component of kind (1) might either have no effect on the performance, or might divert the chain of speech actions into a different chain than the one shown in the figure. The effect would be like the phenomenon of core-phrase diversion described in section 4.4 of *The Neural Embodiment*.

- A defect component of kind (2) would have the effect that the chain of speech actions would stop in execution before the complete core-phrase had been spoken.

- A defect component of kind (3) would result in a distorted muscular activation, giving an audibly defective speech sound, and consequently most likely would also cause the chain of speech actions to break off. This is the kind of speech disturbance which is the characteristic symptom of motor aphasia, discussed in *The neural embodiment* section 6.5.

John Bayley's observations show, first of all, that even at an advanced stage of her Alzheimer disease Iris Murdoch was still able to speak certain particular phrases: 'But I love you', 'Why does he keep saying "education?"', 'When are we going?', 'Do they read books?', 'Why didn't you tell me we were going?', 'Are we going to London?', 'What do you do?', 'When do we go?', 'Why travelling like this. He doesn't know', 'so sorry', 'I see an angel', and 'sailing into the darkness'. Consequently her disease had at that stage impaired only some of the components of her neural system, while some of the components of the sense, the item, and the motor, layers were functioning properly.

Consider now John Bayley's observations of how Iris Murdoch 'begins many sentences, usually with an anxious repetitive query, but they remain unfinished, the want unexpressed'. By this description such sentences start with perfectly well articulated verbal sounds, as they would come in well established core-phrases as spoken normally by Iris Murdoch. But in their delivery they stop before completed. Considered in terms of Fig. 7 (p. 19) *this behavior suggests strongly that they arise as a result of the destruction, the inactivity, of one node of the item layer*, such a node shown as Say: 'see', Say: 'an-', and Say: 'gel'. These nodes get excited from nodes of the sense layer and thereby excite some nodes of the motor layer that in their turn activate come muscles of the speech organs. When just one such node of the item layer is inactive the chain action of the speech will become interrupted at the moment when that node receives excitations from the sense layer.

6. The muscular activity of speech...

As a related observation John Bayley writes on p. 43: 'At cheerful moments, over drinks or in the car, Iris sometimes twitters away incomprehensibly but self-confidently, happily convinced that an animated exchange is taking place.' This phenomenon may be understood as Iris Murdoch's trying to speak the beginning of such phrases that habitually she would utter in the situation, mostly finding that she cannot complete them.

This brings us to another issue described by John Bayley in several places: Iris Murdoch's repetition of certain queries: P. 163: "'When are we going?'" — P. 166: '... At the station she keeps repeating, "Why didn't you tell me we were going?" I had told her many many times. ...' P. 168: "'Are we going to London?'" — "'No, just up the street ...'". The pattern is that she keeps repeating the same question, even after it has been answered repeatedly by John Bayley.

In terms of destruction of the nodes of the item layer the explanation of this pattern of behavior is simple enough. On the one hand, Iris Murdoch will of course ask such questions that she happens to have retained the ability to pronounce, avoiding questions she cannot speak properly. On the other hand, as explained in detail below, when she has lost many nodes of the item layer, it will hold for many of the answers that John Bayley will give to her questions that she simply cannot understand them. They will sound to her as spoken in an unfamiliar tongue. And so having gotten an incomprehensible answer she will repeat the exact question that she has experienced she is able to pronounce.

In summary of this section, the speech defects consist in the patient's inability to pronounce certain well established phrases to their end, stopping short after having spoken one or several of the beginning syllables. The defects are not in evidence in every utterance; they appear only when the patient tries to speak certain particular core-phrases. This is compatible with Alzheimer's disease being the breakdown, one by one, of the nodes of the item layer.

7. Evidence of perceptions in speech

In perception something experienced by the senses is recognized as being the same as something already known by acquaintance. In other words, it is the habitual recognition of something sensed. What is perceived usually changes from one moment to another, as a matter of the changing attention. Often several perceptions alternate rapidly, from one second to the next, from the same or from different sense impressions.

Neurally *perception happens as the excitation of a node of the item layer* from nodes of the sense layer, through synapses of the sense layer, as these synapses have been made conductive as a result of the education of the nervous system. Thus that a particular perception happens at a particular moment is evidence that a particular node of the item layer is functioning at that moment.

What perceptions take place in a person at a particular moment is usually difficult or impossible to determine from the person's behavior at that moment. To the person himself or herself it is usually known by introspection. Sometimes a feasible approach to the determination is to wait for short while, a minute or two, and then to inquire from the person what can be recalled from the recent past. Some of this will be what the person perceived within the past specious present.

Another approach to determining what perceptions take place is to analyze the person's speech. As illustration consider Iris Murdoch's reaction to a talk given over the radio, as reported by John Bayley on p. 162, when she says, first, 'Why does he keep saying "education?"' and later "Do they read books?". Her reactions depend on a complicated

7. Evidence of perceptions in speech...

interplay of a number of components of her nervous system, some of which are shown in Fig. 8. The speech action aggregates indicated in the figure are such that have been activated in lunch time conversations with John Bayley in the past. In the situation they will all receive preactivation excitations from a response habit node, lunch talk, not shown in the figure.

Iris Murdoch's reaction is triggered by her perceptions of the talk on the radio. Her reactions suggest that the talk had produced two perceptions: (1) perception that talk is going on, and (2) perception of the word 'education'. The perception that talk is going on is embodied in excitation of the urge node START SPEAKING QUESTION, excited through the synapse set A.... The excitation of the urge node will through the synapse set K... be further transferred as preactivation excitations into a number of action nodes of such core-phrases that in the past have opened Iris Murdoch's utterances in the present kind of situation.

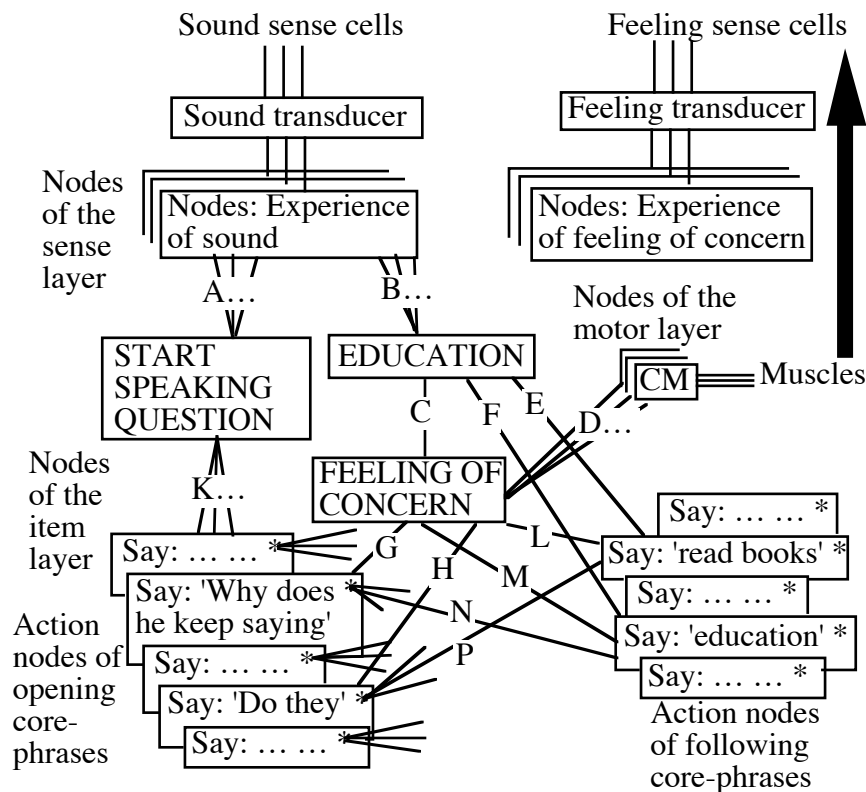


Fig. 8. The embodiment of saying 'Why does he keep saying education?' and 'Do they read books?'

The perception of the word 'education' is embodied in excitation of the node EDUCATION, through the synapse set B.... By Iris Murdoch's established habits of reaction the excitation of EDUCATION arouses her feeling of concern, embodied in the excitation through C of the node FEELING OF CONCERN, with further excitations through the synapse set D... of the node set CM and through these activation of certain muscles, and thereby of certain sense cells that excite certain nodes of the sense layer that thereby generate the experience of the feeling.

The excitation of EDUCATION is transmitted through conductive synapses such as E and F to several other nodes that habitually have been excited at the same time, including the action nodes 'Say: read books *' and 'Say: education *'. Similarly, the excitation of FEELING OF CONCERN is transmitted through conductive synapses such as G, H, L, and M, to several other nodes that habitually have been excited at the same time, including the

7. Evidence of perceptions in speech...

action nodes 'Say: Why does he keep saying *', 'Say: Do they *', 'Say: read books *', and 'Say: education *'. The action node 'Say: read books *' is further connected through P as habitual follower of 'Say: Do they *', and 'Say: education *' is connected through N as habitual follower of 'Say: Why does he keep saying *'.

Iris Murdoch's reaction in the situation undoubtedly depends on the excitation of several other nodes of her item layer beyond those that are shown in Fig. 8 (p. 22). However, the above analysis is sufficient as a plausible explanation of how it comes about that her perception of the talk on the radio makes her respond with the pronouncements recorded by John Bayley. The analysis shows that Iris Murdoch's speech in the situation results from her perception of only a small part of the spoken phrases she hears. Her reactions are entirely compatible with the hypothesis that the Alzheimer disease happens by the decay, one by one, of the nodes of the item layer, while at any time some of these nodes remain intact. Those still intact happen to include the 14 nodes that provide the muscular activations of saying 'Why does he keep saying "education?"' and "Do they read books?"

Now consider Iris Murdoch's reaction in another situation, as reported by John Bayley on p. 169:

'... the guest who is talking to Iris. He is giving a tremendous impression of being good at his work, and happy at it. Half listening, while at the same time engaging my own opponent closely, I overhear a lively account of the way things are done in an Insurance Adjustment office. Smiling Iris listens closely—her attention must be flattering. Then I hear her say: "What do you do?" From the face opposite her it is evident that the question has been repeated several times in the last few minutes.'

A normal person in the situation described here, in conversation as a guest at a Sunday morning drinks party, would have a variety of alternating perceptions. By visual sensations the person will perceive the other guest as a human being. By auditive sensations the person will have perceptions of the series of subjects and qualities being spoken of by the other guest. By these perceptions the nodes of the person's item layer that embody the issues—the human being and the subjects and qualities—will become strongly excited for the duration of the specious present, and by these excitations will influence the person's behavior. This behavior typically will come to include bodily expressions of feelings experienced, such as facial expressions, and speech about the subjects and qualities spoken of by the other guest.

By John Bayley's report Iris Murdoch displays two reactions in the situation: she smiles and displays attention in a flattering way, and in her speech she repeats the same question: "What do you do?" From these reactions the plausible inference is that she has normal perception from visual impressions of the guest she is speaking to, while from the speech from the guest she has had perception only of this as being speech sound from a male person but very little perception of the single words and phrases of that speech. *This suggests that a large number of the nodes of her item layer that embody subjects and qualities talked about by the guest have ceased to function.*

Consider now the perceptions involved in the situation already discussed above, described by John Bayley on p. 177: 'Jim washed and cut her hair in Lanzarote; Audi gave her a shower and a bath. She said to Audi as they stood together in the shower, "I see an angel. I think it's you."'

7. Evidence of perceptions in speech...

Fig. 9 shows some of the neural components in Iris Murdoch's neural system that would have become perceptually excited in the situation if all those components had been in normal operation in the situation. Having visual sensations of the person before her in the

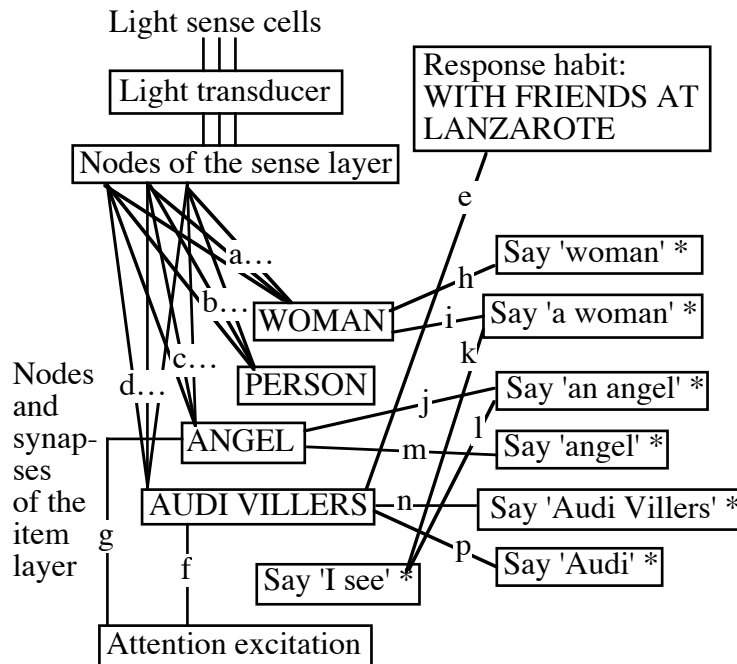


Fig. 9. Iris Murdoch's perceptions when seeing Audi Villers and saying 'I see an angel'

shower, a number of nodes of her item layer would have become perceptually excited through such synapse sets as a..., b..., c..., and d..., including WOMAN, PERSON, ANGEL, and AUDI VILLERS, and undoubtedly a number more. Of these nodes AUDI VILLERS would already have received preperception excitation through synapse e from the response habit node WITH FRIENDS AT LANZAROTE. As a result, of all these nodes AUDI VILLERS would have been the one to have its attention synapse f excited. And so of the speech action nodes associated with these nodes it would have been Say 'Audi Villers' and Say 'Audi' which would have received strong preactivation excitations, and would have been activated in speech about what was perceived in the situation.

However, as reported by John Bayley the node actually activated was Say 'an angel'. This may be understood to have arisen if such nodes as WOMAN, PERSON, and AUDI VILLERS, had become inactive, while ANGEL and the nodes of the action aggregates Say 'an angel'* and Say 'I see'* remained intact.

As yet another case of Iris Murdoch's reaction to speech, consider her reaction reported by John Bayley on p. 163:

“When are we going?”
 “I'll tell you when we go.”

Iris always responds to a jokey tone. But it is sometimes hard to maintain. Violent irritation possesses me and I shout out before I can stop myself, “Don't keep asking me when we are going!”

7. Evidence of perceptions in speech...

Plausibly Iris Murdoch sensed the sounds, but had no, or quite incomplete, perception of the sounds of the answer "I'll tell you when we go". If so they were to her mostly as if spoken in an unknown tongue. That would be the case if she had *lost the subject nodes* of some of the words of the phrase.

Iris Murdoch's failure to perceive many spoken English words is confirmed by what John Bayley writes on p. 151: '*Jackson's Dilemma* came out and got exceptionally good reviews. I read these reviews to Iris, a thing I had never done before because she had never before wanted to listen. Now she listened politely but without understanding.'

8. Perception revealed in feeling reactions

In some situations an observable behavioral manifestation of perception is generated by the muscular activations that produce feelings excited by the object perceived. The commonest such manifestations are facial expressions such as smiles.

The neural mechanism of the generation of the experience of a feeling from a muscular activation is shown in Fig. 10. This shows a typical sample of the neural components of a normal neural system involved in the individual's responses at a particular moment of a particular situation. The figure displays the components that by being excited at the moment contribute mostly to the person's perception of some visible and/or audible subject and to the person's attendant experience of the feelings that habitually have been aroused in the person by that subject.

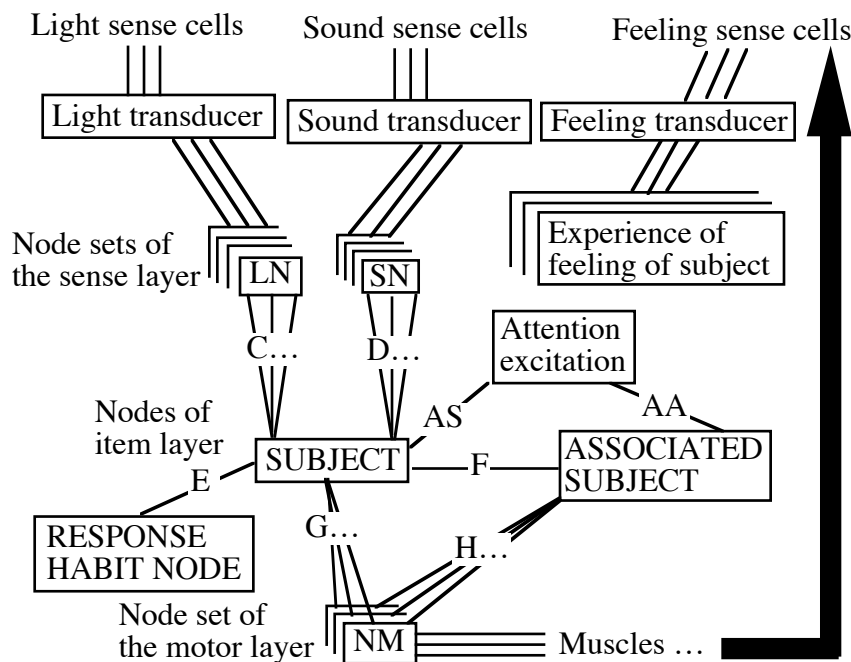


Fig. 10. Experience of feeling aroused by perception of visual and/or auditive sensation

At a moment of perception of the subject embodied in the node SUBJECT the excitation of the node SUBJECT is formed by summation in the node of the excitations coming from RESPONSE HABIT NODE through the synapse E, through the synapse sets C... and D..., from sense impressions of light and sound, and through the synapse AS from the Attention excitation. With a subject that habitually upon perception arouses feelings the excitation of SUBJECT will through the synapse set G... activate the node set NM and thereby a set of

8. Perception revealed in feeling reactions...

muscles. Feeling sense cells in the tissue around these muscles will become excited, and will through the Feeling transducer excite a set of nodes of the sense layer, which by their excitation produce the experience of the a certain feeling, the feeling aroused by the subject.

With many subjects this arousal of feelings from perception will be combined with additional feelings aroused from subjects associated with the subject. Neurally this mechanism is shown in Fig. 10 (p. 25) in the form of the node ASSOCIATED SUBJECT which is connected to SUBJECT through the conductive synapse F. When SUBJECT is strongly excited from sensations, ASSOCIATED SUBJECT will also become excited and may contribute strength of feeling through the conductive synapse set H....

As apparent from Fig. 10 (p. 25) the activation of the muscles that produce the experience of the feeling is evidence that the visual and auditive sensations have led to perceptual excitation of SUBJECT.

Several instances of Iris Murdoch's feeling response to perception is reported by John Bayley. On p. 34 he writes:

'... If an admirer or friend asks her to sign a copy of one of her novels she looks at it with pleasure and surprise ...

Once in the water Iris cheers up a bit. It is almost too warm, hardly refreshing. But its old brown slow-flowing deliciousness remains, and we smile happily at each other as we paddle quietly to and fro.'

Another case of Iris Murdoch's feeling reaction to her perception of a person is reported by John Bayley on p. 176:

'When I get back the woman, a nice-looking person, is awake, and distraught, desperately trying to regain the handbag and other possessions which had been on the seat beside her. I take them from Iris and put them back, apologising again in a whisper. Iris says, "So sorry", gives the woman her beautiful smile.'

Iris Murdoch's smiling response is evidence that she has perception of the woman in the bus to Oxford.

In cases where the feeling response originally learned includes the response from associated subjects, the feeling response will be weaker if in the Alzheimer victim some of the nodes of the associated subjects have become inactive. This will explain several of the reactions reported by John Bayley:

P. 45: 'Trying to cheer her up one day I thought of an inane childhood rhyme, forgotten for years.

Mary had a little bear
So loving and so kind
And everywhere that Mary went
You saw her bear behind.

Iris not only smiled — her face looked cunning and concentrated.'

P. 60, 'I recently came across a collection of palindromes somebody sent us years ago — ingenious and surreal sentences, appropriately illustrated. One of them, which had amused us as much by the illustration as by the telegraphic simplicity of the palindrome, was "Sex at noon taxes." Recently I showed this and other one-time favourites to Iris, and she laughed and smiled a bit, out of the wish to share them with me, but I knew that they were not getting through.'

8. Perception revealed in feeling reactions...

P. 43, 'The continuity of joking can very often rescue such moments, Humour seems to survive anything. A burst of laughter, snatches of doggerel, song, teasing nonsense rituals once lovingly exchanged, awake an abruptly happy response, and a sudden beaming smile At cheerful moments, over drinks or in the car, Iris sometimes twitters away incomprehensibly but self-confidently, happily convinced that an animated exchange is taking place. At such moments I find myself producing my own stream of consciousness, silly sentences or mashed-up quotations. "The tyrant of the Chersonese was freedom's best and bravest friend", I assure her, giving her a solemnly meaningful look. At which she nods her head gravely, and seems to act a conspiring smile, as if the ringing confidence of Byron's line in "The Isles of Greece" meant a lot to her too.'

'1 March 1997 p. 162: '... We can still talk as we did then, but it doesn't make sense any more, on either side. I can't reply in the way I used to do then but only the way she speaks to me now. I reply with the jokes or nonsense that still makes her laugh.'

The loss of well established subjects does not prevent new subjects from becoming established in the patient. This is in evidence in some of the feeling responses reported by John Bayley, p. 158:

'20 February 1997 — Teletubbies. They are part of the morning ritual, as I try to make it. I have to insist a bit, as Alzheimer's now seems to have grown inimical to routines. Perhaps we all know by instinct that an adopted routine preserves sanity?

Just after ten, as part of the BBC 2 children's programme, the Teletubbies come on. One of the few things we can really watch together, in the same spirit. "There are the rabbits!" I say quite excitedly. One of the charms of this extraordinary programme is the virtual reality landscape supplied. An area of sunlit grass — natural — dotted with artificial flowers beside which the real rabbits hop about. The sky looks authentic as well, just the right sort of blue with small white clouds. The Teletubbies have their underground house, neatly roofed with grass. A periscope sticks out of it. A real baby's face appears in the sky, at which I make a face myself, but Iris always returns its beaming smile.

The creatures emerge, four of them, in different coloured playsuits. ... They trot about, not doing anything much, but while they are there Iris looks happy, even concentrated. ...

As we got in the car I said to her reassuringly, "Soon be back in Teletubby land." But I don't think she remembered what Teletubbies were.'

From this evidence of her feeling reactions it is clear that Iris Murdoch at this stage had perception, with experience of associated feelings, from the visual sensations received from the television pictures of the Teletubbies.

However she had developed no habit of perception from the aural sensation of the spoken sound 'Teletubby land'. This lack of perception is no evidence of her Alzheimer disease. It merely shows that she had not learned they were called Teletubbies. (John Bayley's phrase 'I don't think she remembered what Teletubbies were' is a typical example of the common misleading faculty-psychological way of describing mental states).

However, when perception does not take place, instinctive reactions such as what William James describes as the instinct of 'fear of strange men and animals, of black things and holes, of high places, of the supernatural' take over and excite feeling reactions of fear. John Bayley writes:

8. Perception revealed in feeling reactions...

P. 45, 'The Alzheimer face has been clinically described as the "lion face". ... The features settle into a leonine impassivity which does remind one of the King of Beasts, and the way his broad expressionless mask is represented in painting and sculpture. The Alzheimer face is neither tragic nor comic, as a face can appear in other forms of dementia: that would suggest humanity and emotion in their most distorted guise. The Alzheimer face indicates only an absence: it is a mask in the most literal sense.'

15 April 1997 p. 168. 'Iris's fear of other people if I'm not there is so piteous that I cannot bring myself to arrange for carers to "keep her company".'

The reaction of fear noted here is evidence that the subject node embodying 'other people' is gone.

A similar reaction of fear has already been described above:

'20 November 1997', p. 176: '... Peter puts us on the bus for Oxford. Sink back thankfully. Nearly home. Bus cruises steadily on through the dark, seeming to shrug off the rush-hour traffic on either side of it. The few passengers are asleep. But we have no sooner started than Iris is jumping up and down in agitation. Where are we going? Where is the bus taking us? ...'

Getting out of the 'lion face' state requires perception of some sensuous impression. This is conditioned on the functioning of a subject node of the item layer that is still intact.

9. Concluding discussion

As perhaps the most remarkable feature of the present discussion it should be noted how a number of very dissimilar symptoms of Alzheimer's disease have been accounted for in terms of one and the same cause, the successive decay, one by one, of the nodes of the item layer. To mention just three of these symptoms: (1) Iris Murdoch's introspective observation of her loss of a character in a book she is writing. (2) John Bayley's observation of Iris Murdoch's failure to respond in a literary discussion according to her established habits. (3) The feature of some of Iris Murdoch's speech, observable both introspectively and by her behavior, of her being unable to complete her pronouncement of certain phrases that previously were well trained parts of her speech habits.

These features of the present analysis come about by the fact that the synapse-state theory explains the various mental functions, not by an assumption of a number of specialized neural organs or faculties, but by the assumption of a number of different node/synapse aggregates, each such aggregate being distinct and achieving its function merely as a consequence of the conductivity states of a number of synapses. The node/synapse aggregates are accommodated entirely within the neural structure shown in Fig. 3 (p. 5). They came about by the education of the nervous system of the individual.

It should further be noted that the understanding of mental functions in terms of node/synapse aggregates is not a feature of just the present analysis of a case of Alzheimer's disease but, as presented in Naur (2008) chapter 3, is a core issue of the description of normal mental life.

In summary, the present account of a case of Alzheimer's disease is a strong confirmation of the validity of the synapse-state theory of mental life.

Acknowledgements

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Overtime a person with mild cognitive impairment can progress into Alzheimer's disease. There are four main types of mild cognitive impairment: Amnesic, non-amnesic, single domain and multiple domain. Amnesic MCI is when memory is significantly impaired but other cognitive functions remain functioning. Those with multiple domain MCI are at a greater risk of developing Alzheimer's disease. Chronic stress increases risk of amnesic mild cognitive impairment in elderly. A new study suggests that stress experienced by the elderly increased the risk of mild cognitive impairment " a precursor to Alzheimer's disease. The findings revealed that stressed elderly were twice as likely to become impaired compared to those who were not. Many reports have described that individuals with Alzheimer's disease show neural breakdown in the brainstem nuclei, hippocampus and auditory cortex in the temporal lobe of the brain. However, it is still unclear whether auditory skills mediated by these areas differ across individuals with and without Alzheimer's disease and how these auditory skills are further confounded by reduction in cognitive function in individuals with AD. Our aim was to address this issue in a prospective longitudinal setting. Tests of central hearing function were performed on 70 subjects with either Alzheimer's disease (AD) or mild cognitive impairment, and in controls with subjective memory complaints but normal cognition. The time span [Show full abstract] until follow-up was 1.5 years.