The transformer revisited

Michael Macdonald-Ross and Robert Waller

Written in 1974 while the authors were with the Open University, this paper first appeared in the 1976 *Penrose Annual*.

The original abstract, written by the Penrose editor, read: Break down the barriers in the interests of the reader. Take responsibility for the success or failure of the communication. Do not accept a label or a slot on a production line. Be a complete human being with moral and intellectual integrity and thoroughgoing technical competence. This is the message of this article by two highly professional communicators at the Institute of Educational Technology of the Open University, Milton Keynes. It examines the range of complex problems involved in putting the expert's message in a form the ordinary person can best understand and use.

It is reprinted here with minor changes that mostly reflect the current unacceptability of the pronoun 'he' used generically. The authors have also added a 2000 Postscript.

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How can we organise complex information for the benefit of the reader? This question is important, for in a modern society people cannot always meet face to face: often we must get the information we need from documentary sources – pieces of paper or computer files. The Open University is a case in point: we use correspondence texts as our main teaching medium. The effectiveness of these texts is naturally of great concern to the University; and by our research we try to help the University improve the quality of its printed teaching material. However, the issues we raise here are not peculiar to our own situation. The school system has its text-books, the industrial corporation has its field servicing, the armed forces have their training systems, Government departments must inform the public: all these organisations depend on information, and this information is usually communicated in text form. We think the principles that apply to us apply (with variations) to these related cases.

One person talking to another – that everyday sight we take so much for granted – can usually make himself understood. Talking face to face people deploy complex techniques almost instantly, without self-conscious thought. But, how much more difficult it is to make oneself clear to a reader one cannot see, and who cannot ask questions. So, as one might expect, *communication breakdowns* are quite common, and can have the most serious effect. Recently farmers were advised to cut down trees suffering from Dutch Elm disease – but were not told to burn the wood! And how often have we met forms we could not fill in or regulations we could not properly understand? (The Government's 'brief guide' to VAT was a small encyclopedia packed with officialese.) This bungling incompetence occurs often and is too serious for us to accept complacently. We must do something about it.

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Like most organisations of our age, the Open University has a production-line system. Many different people help create the teaching material: authors, educational technologists, editors, designers, illustrators, photographers, television producers. All these work in separate departments, often quite unco-ordinated one with another, and all too often mutually suspicious rather than co-operative. No one person is responsible for mediating the whole creative process. With so many fingers in the pie it follows (of course) that *important things are left undone and no-one accepts responsibility for the success of the texts as instruments of communication*. In our opinion the University works not so much because we are expert at distance teaching, but because, in the main, students are keen, intelligent and hardworking.

We suggest that these large organisations lack a crucial process – *transformation* – and a person to carry the process out – the *transformer*. This is the skilled professional communicator who mediates between the expert and the reader. The transformer's job is to put the expert's message in a form the reader can understand, and to look after the reader's interest in general. For example, any reasonable query the reader might have should be thought about and catered for in a proper manner. Put this way the role seems simple, but it is not. A transformer needs a good general education and a wide range of particular technical skills. Transformers will find themselves dealing with all kinds of experts, most of whom do not know what they want to say, or how to say it; they will discover how little is really known about the readers, and the techniques they need are scattered around in the most unlikely places.

We would like to have you think that the idea of the transformer is our own, freshly minted. However, it is not. The name was first coined by Otto Neurath when he developed the system of graphic communication known as Isotype. Though we extend the idea beyond its original scope, Neurath's basic idea was correct, important, and ... ignored for half a century!

At last there are signs that Neurath's long-dormant idea might get the attention it deserves. We see with interest how some now call themselves 'editorial designers' to say that both text and graphic elements must be handled together, as a unity. Also we see courses in 'Information graphics' springing up. Such a label says to us that design can be more than external decoration,
it can help the way the message itself is constructed. And we see that some professions of recent origin do have one person in charge of the creative process (creative directors in advertising agencies and producers of television programmes). Even our own Institute is thinking of changing its name to the Institute of Educational *Development*. The word development suits the notion of transforming quite well. The word 'transformer' has not yet been bagged by any of these groups, and so maybe can be accepted by them all.

The transformer starts with what to say, and then resolves how best to say it. Naturally, this distinction must not be overdone. What you want to say does partly determine how you say it and, in return, the content of a message is always altered to some extent by the way it is put over. Nevertheless, the distinction is a useful one. First one discusses the *content* of the message with the experts; later one works

It is the responsibility of the 'transformer' to understand the data, to get all necessary information from the expert, to decide what is worth transmitting to the public, how to make it understandable, how to link it with general knowledge or with information already given in other charts. In this sense, the transformer is the trustee of the public.
Marie Neurath (1974)

out the exact *form* of the message with the help of illustrators, photographers, printers and other technical staff. The skills needed and the problems faced differ at each stage. The cycle is complete when the transformer discovers what *effect* the message has on the reader.

The transformer is overseer of the whole process of communication – what is said, how it is said and what its effect is. They work with colleagues whose skills are more specialised to make sure the message gets across and to reduce the chance of communication breakdowns. Transformers act on the reader's behalf as best they can, sorting out the kind of issues a reader might raise if they were present in person.

What to say

Transformers must be as closely involved with the content of the message as they are later with its presentation. They must understand the subject at hand so that their later judgements are *informed* judgements; but there is more to it than that. The transformer will usually need to help the expert get his or her ideas sorted out so that the subsequent act of communication has some chance of being successful.

The transformer is the partner of the subject matter expert and not their slave. Our experience suggests that experts are not always as expert as they seem at first sight, and even published statistical data may be unreliable or misleading. Moreover, the expert's natural tendency is to think of their subject rather than to think of the reader. For reasons of this kind, the transformer should not accept an author's instructions without critical thought. They must question and analyse until they can put the author's intentions in proper perspective. The idealistic young communicator may be surprised to find their source vague and confused instead of clear and authoritative, but the expert is only human! They may not have organised their ideas yet; they may feel uncertain and anxious about issues that they have not sorted out but which cannot be ignored. The transformer helps as a sympathetic listener who gently refuses to go away until the confusion is sorted out. At any rate, you must stick to it, for no-one can make a good communication out of muddled thinking.

The transformer sets about their task with the help of two insights: a good communication is *selected for a purpose* and has a *sound logical structure*. These two insights lead to the techniques which a transformer can use in discussions with the source:

Purpose and objectives

All human communication depends on artful selection, since one can never say all that is known. The simplest basis for selection is a clear statement of purpose. The dialogue between expert and transformer may start with vague statements like: the reader should have some idea of this or should appreciate that. The transformer works to derive objectives which are as precise as the particular situation requires. For example, they may ask, *what will a successful outcome look like?* What will the reader be able to *do* if they have interpreted the message correctly? After clarifying what the expert wants to say and why they think it worth saying one can discard irrelevant material and identify the prospective pay-off for the reader.

Tasks and errors

Sometimes the work on the objectives must be supported by the kind of professional study often found in military or industrial training. If the reader is to perform a well-specified function or activity, then that activity can be

analysed into its constituent tasks, and typical mistakes can be collected and analysed. Often such a study starts with the 'master performer' – an experienced person who exhibits all the skills and know-how necessary to meet the most demanding job standards. Such a study justifies the selection of objectives by *connecting the message with the reader's world*.

Organising principles

In education we make less use of the notion of tasks and errors and more use of organising principles. All subjects consist of facts, arguments, theories, problems and procedures which (to a greater or lesser extent) are unified by central themes or organising principles. Sometimes these principles are quite grand, covering vast domains (the theory of evolution would be one such example). Sometimes the principles are more practical, for instance, computers can only carry out those operations which can be exactly specified in a predetermined code. Sometimes (as in the social and human sciences) one finds competing world views which one must understand in order to interpret the opinions of the experts. Such world views are to some extent *mutually exclusive* and a transformer must realise that they lie behind and largely determine what experts say and do. The principles help us organise a map of the terrain.

Facts

It is a *fact* that 8 per cent of men (but only 0.4 per cent of women) have defective colour vision. It is a fact because experts agree on what 'defective colour vision' means: there are standard tests to identify it and the results of key investigations are not in dispute. On the other hand, if someone says 'whites are more intelligent than blacks' then the status of such a statement is much less clear. The statement is not known to be true; but it is not known to be untrue – it is in dispute, contentious, unsayable, and offensive even to research. Therefore the job of a transformer is to intercept opinions or interpretations masquerading as facts. They must identify the *status* of any key statements made by the expert.

Arguments

People differ in their ability to deploy arguments in an appropriate manner. This is too big a subject to be fully treated here, but so important that it must be mentioned. The transformer's dream is to see all arguments valid and all propositions as they claim to be (true, untrue or uncertain as the case may be). Although this is the kind of quest which never quite ends, even a moderate amount of success does a good deal to ease the reader's problems.

Bias

Most people welcome a second opinion to help get the balance of an article right, but thoroughgoing deliberate bias is difficult to cure. The transformer may be resisted because the author, or even the whole organisation, has a vested interest in maintaining the bias. Companies may wish to hide defects in their products or in their finances; Government departments may not wish the public to know

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And the next morning they issued not twenty ounces of bread – the prisoner transport ration at the time – but no more than nine ounces ... in the event, only one loudly asked the guard distributing the bread:

'Citizen chief! How much does this ration weigh?'

The whole car fell silent. Many waited before beginning to eat their ration, expecting that theirs, too, would be reweighed. And at that moment, in all his spotlessness, the officer appeared ...

'Which one here spoke out against the Soviet government?'

All hearts stopped beating.
Solzhenitsyn, The Gulag Archipelago, 1973

their full rights under the law; lecturers nowadays do often allow their political opinions to colour their courses. In such cases transformers may get caught by their dual loyalties. If they cravenly submit to their colleagues then they are just lackeys (running dogs); if they side entirely with the reader then maybe they can no longer influence their own organisation (paper tigers!). The transformer should play for honesty and integrity, qualities which do tend to pay off in the long run. Otto Neurath used to say that 'the transformer is the trustee of the public'. That is a pretty fair way to put it.

> The English Language becomes ugly and inaccurate because our thoughts are foolish, but the slovenliness of our language makes it easier for us to have foolish thoughts ... Millions of peasants are robbed of their farms and sent trudging along the roads with no more than they can carry: this is called *transfer of populations* or *rectification of frontiers*. People are imprisoned for years without trial, or shot in the back of the neck or sent to die of scurvy in Arctic lumbercamps: this is called *elimination of unreliable elements*.
> *George Orwell, 'Politics and the English Language' 1946*

How to say it

The transformer's job now is to plan the *presentation* of the message. Since text can only use printed language and graphic devices to put over the message, to do this they need skill as a writer and editor, and as a typographer and graphic communicator. Of course, they do not have to write or draw everything themselves – but they must be skillful enough to ensure that the presentation enhances the message.

Language

No transformer can hope to succeed unless he or she is a skilled wordsmith. Experience and experiment teach us that simple sentences with active verbs and familiar words can be read and understood by most adults. As the words get less familiar and the construction gets more complex, so more and more readers fall by the wayside. Different target populations have different levels of reading competence, and it is the job of the transformer to know their audience, to make sure the language is tailor-made to their requirements. Reading tests can be used to assess the competence of the target population, readability measures can be used to predict the difficulty of the text and there are many books which show how to write clear English. We are particularly fond of the books by Harold Evans and Leslie Sellers*, which show how much we can learn from those Fleet Street sub-editors who daily put complex ideas in a form which can be read and enjoyed by the general public.

Links

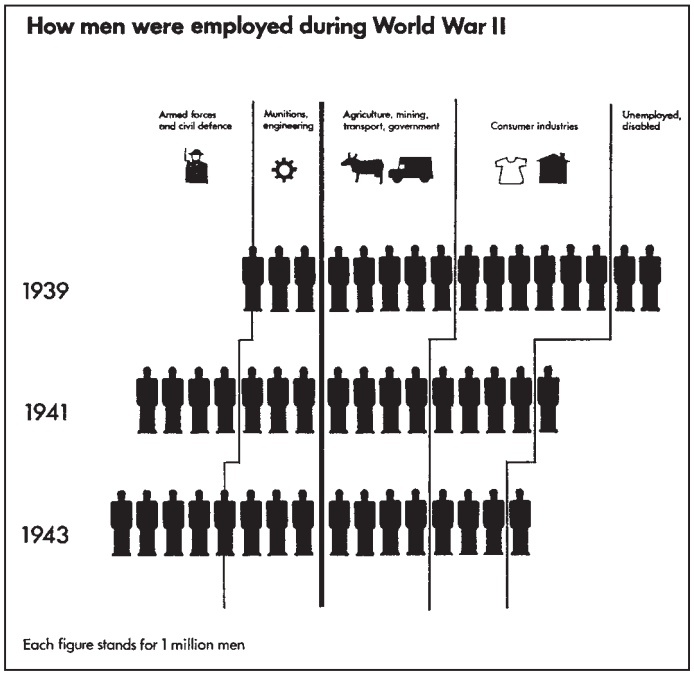
New or difficult ideas can be grasped by the reader, but only if you make the right connections with his familiar world. By his explanations and choice of examples the transformer can make difficult ideas seem easy because they are linked to things the reader already understands. In this way good writing makes use of a reader's own knowledge and experience. Technical terms can, if necessary, be put so that we can all understand, yet at the same time the transformer must not debase the original notion by sloppy thinking or unclear expression. Explanations can and should be checked with the expert, and reference books consulted.

* see Evans, H. (1973) *Newspaper design*. London: Heinemann; Sellers, L. (1968) *The simple subs book*. Oxford: Pergamon Press.

TABLE 1 NUMBER OF MALES AGED 14-64 IN GREAT BRITAIN — Thousands

Mid-year	Armed Forces (1)	Whole-time Civil Defence	Industrial groups			Unemployed	Rest of male population (5)	Total male population aged 14–64
			Group I (2)	Group II (3)	Group III (4)			
1939 ...	477	80	2,600	4,688	5,798	1,043	1,324	16,010
1941 ...	3,271	324	3,140	4,264	4,116	158	704	15,977
1942 ...	3,785	304	3,285	4,154	3,553	103	750	15,934
1943 ...	4,284	253	3,305	4,040	3,093	76	870	15,921
1944 ...	4,502	225	3,210	4,059	2,900	71	943	15,910

(1) These figures, and also the total column, exclude prisoners and missing.
(2) Munitions industries, i.e., iron and steel, non-ferrous metals, shipbuilding, engineering, aircraft and vehicles, instruments, chemicals, explosives, etc.
(3) Agriculture, mining, National and Local Government, transport, shipping (including Merchant Navy), public utilities, food manufacture.
(4) Building, textiles, clothing, distribution, professional services, etc.
(5) Schoolboys, students, invalids (including war invalids), retired, etc.



Typography and graphics

To attract and keep interest and to ensure legibility are the classic aims of the designer and the typographer. These aims are still important, but the transformer must have a much broader vision than that. Often the graphic elements carry a crucial part of the message, so one cannot regard design as just external decoration applied to an existing message. Rather, we go along with the ideals of the New Typographers: design is an integral part of the communication process. Good typography helps readers plan their reading strategy, tells them where they are and helps them to find their way about; good graphic design allows one to say in words and illustrations what could not be said in either form alone. We show three examples of graphic communication: an algorithm, an Isotype chart and a table. They illustrate perfectly the kind of problems a transformer may face daily, and are well worth careful study. There are other specialised techniques (especially in mathematics, science and technology) which the transformer must collect as the need arises.

Real Isotype diagrams require the process of transformation. Marie Neurath of the Isotype Institute produced the pictorial chart from the table above

- notice the clarity and simplicity of the language and symbols
- the information load has been cut to leave the message clear. Only alternate years are shown, and the change of scale means fewer man-symbols
- the prominent main caption is important – it defines the context of the statistics
- Isotype charts do not just display statistics – they aim to show what the statistics say – and to give visual impact to their message.

TABLE 2 MIGRATION INTO AND OUT FROM THE UNITED KINGDOM, BY NATIONALITY AND COUNTRY OF LAST PERMANENT OR INTENDED FUTURE RESIDENCE[ab]

Thousands

	1964		1965		1966		1967		1968	
	In	Out	In	Out	In	Out	In	Out	In	Out
Total migrants	211.0	271.4	206.3	284.3	219.2	301.6	225.0	309.0	221.6	277.7
Commonwealth citizens	144.0	232.2	140.0	250.6	142.3	262.9	157.0	268.5	165.2	240.2
Country of last permanent or intended future residence[a]:										
Commonwealth countries										
Total	115.6	167.1	111.7	187.3	111.0	203.1	129.5	198.3	136.7	169.3
Australia	15.2	79.8	19.0	90.4	19.7	84.9	27.7	81.9	27.1	82.9
Canada	9.2	30.9	9.1	41.1	8.9	62.2	9.9	62.2	12.2	3.92
New Zealand	5.9	16.0	6.5	14.7	6.9	15.8	7.7	15.3	9.7	8.0
African countries[d]	21.8	16.7	20.5	16.5	20.5	15.7	17.3	16.4	23.1	17.1
Bangladesh, India, Pakistan and Sri Lanka	27.6	8.8	23.6	9.1	26.7	8.7	39.4	7.6	40.1	6.7
West Indies[e]	19.0	7.3	17.3	8.1	14.8	8.6	13.0	8.3	11.1	9.6
Other countries	16.8	7.6	15.5	7.5	13.5	7.2	14.5	6.4	13.5	5.7
Foreign countries										
Total	28.5	65.1	28.3	63.3	31.3	59.8	27.4	70.3	28.5	70.9
South Africa	2.3	13.1	2.7	11.7	4.8	12.3	3.3	13.0	3.7	16.0
Latin America	1.0	1.6	0.7	1.2	1.0	1.0	0.7	1.6	1.0	1.8
United States	7.5	22.0	8.3	20.5	8.4	18.9	7.4	25.9	7.2	22.4
Western Europe[f]	11.8	22.6	12.9	22.6	12.8	18.7	11.4	22.9	12.7	23.2
Other countries	5.8	5.9	3.7	7.3	4.3	8.8	4.7	6.9	4.0	7.5
Aliens	67.0	39.3	66.3	33.7	76.9	38.7	68.0	40.5	56.5	37.5
Country of last permanent or intended future residence[a]:										
Commonwealth countries	2.1	2.7	1.6	2.7	1.6	4.3	2.4	4.5	1.2	2.9
Foreign countries										
Total	64.9	36.6	64.6	31.0	75.3	34.4	65.7	36.0	55.3	34.6
United States	11.3	8.2	11.8	7.3	14.3	8.2	14.7	8.2	11.7	8.7
Western Europe[f]	42.5	23.0	43.7	19.0	47.2	19.6	39.4	19.3	30.6	19.5
Other countries	11.0	5.5	9.1	4.8	13.8	6.6	11.5	8.5	13.0	6.5

a Based on the self-description in the International Passenger Survey of an emigrant as a person who says he intends to reside outside the United Kingdom for a year or more, having resided in the United Kingdom for a year or more, and *vice versa* for an immigrant.

b Excluding the Irish Republic.

Source: Central Statistical Office (1973 pp 20–1).

Migration into and out of the United Kingdom (in thousands)

	1966		1967		1968		1969		1970	
	In	Out	In	Out	In	Out	In	Out	In	Out
Commonwealth citizens going to or coming from										
The Commonwealth										
Africa	22	17	20	16	20	16	17	16	23	17
Asia	28	9	24	9	27	9	40	8	40	7
Australia	15	80	19	90	20	85	28	82	27	83
Canada	9	31	9	41	9	62	10	62	12	4
New Zealand	6	16	6	15	7	16	8	15	10	8
West Indies	19	7	17	8	15	9	13	8	11	10
Other	17	8	15	7	13	7	14	6	13	6
Total	*116*	*168*	*110*	*186*	*111*	*206*	*130*	*197*	*136*	*171*
Foreign countries										
South Africa	2	13	3	12	5	12	3	13	4	16
United States	7	22	8	20	8	19	7	26	7	22
W. Europe	12	23	13	23	13	19	11	23	13	23
Other	7	7	4	8	5	10	5	9	5	9
Total	*28*	*65*	*28*	*63*	*31*	*60*	*26*	*71*	*29*	*70*
Aliens going to or coming from										
The Commonwealth										
Total	*2*	*3*	*2*	*3*	*2*	*4*	*2*	*4*	*1*	*3*
Foreign countries										
United States	11	8	12	7	14	8	15	8	12	9
W. Europe	42	23	44	19	47	20	39	19	31	19
Other	11	5	9	5	14	7	11	8	13	6
Total	*64*	*36*	*65*	*31*	*75*	*35*	*65*	*35*	*56*	*34*
Total Commonwealth	144	233	138	249	142	266	156	268	165	241
Total Aliens	66	39	67	34	77	39	67	39	57	37
Total Migrants	210	272	205	283	219	305	223	307	222	278

A criticism of the rather baffling table above can help us to design a better alternative:

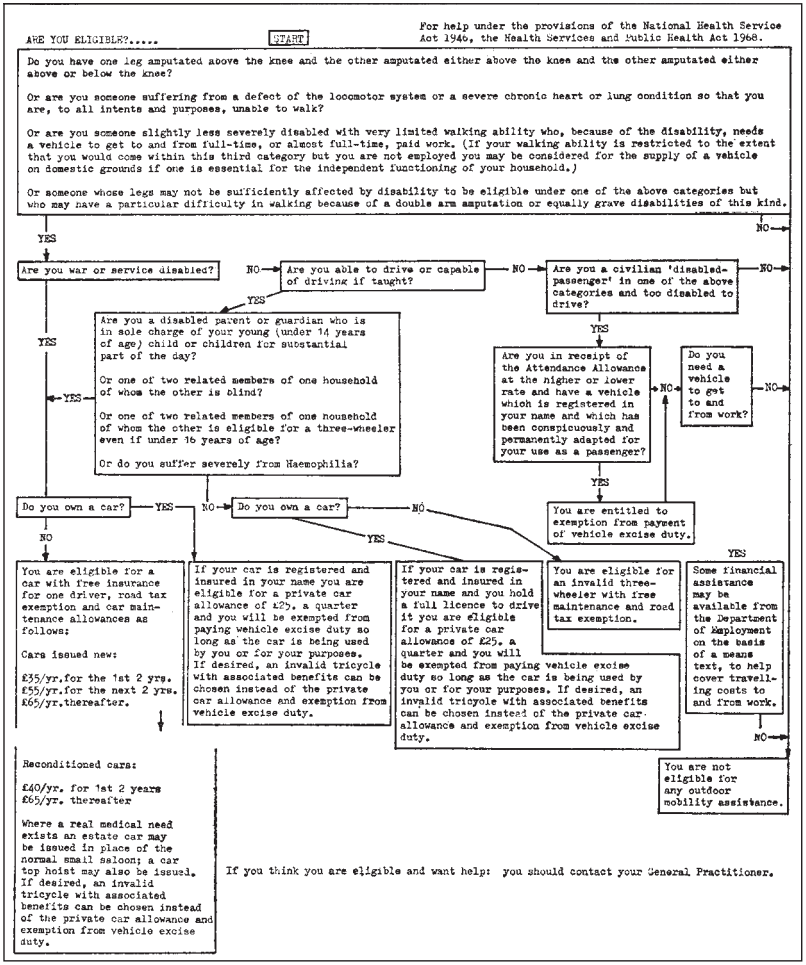
- 'country of last permanent or intended future residence' is hard to understand.
- the monotonous typography makes similarly worded items of different status look alike.
- evenly spaced columns and old-style numerals make the figures hard to compare.
- insensitive use of space means that 'total' rows of figures are often visually associated with the wrong sections.
- typographic confusion also results from an attempt to save money by using only one size and style of type throughout the publication.

A transformer needs educational, editorial and typographic skills and also a questioning spirit to produce the result pictured top right.

- obscure wording is simplified.
- typographic and spatial coding is used to associate like with like.
- the 'total' figures have been grouped together to avoid confusion and to provide a summary of the table.
- one of the aims of the course is to help students develop skills in interpreting tabular statistics. A pictogram would thus be inappropriate, although possibly more effective in other ways.
- when we traced the statistics to source, we found that the figures were derived from quite small-scale surveys of air and sea passengers. Thus we decided to cut out the decimal point.

This example was written for the Open University course 'The Handicapped Person in the Community' (P853). Ten years ago Brian Lewis and Peter Wason showed that the structure of rules and regulations could be displayed better as algorithms (logical trees). But to do this the details of the design must be right. Although the author's basic idea is reasonable the original version is linguistically complex, logically confused and graphically chaotic.

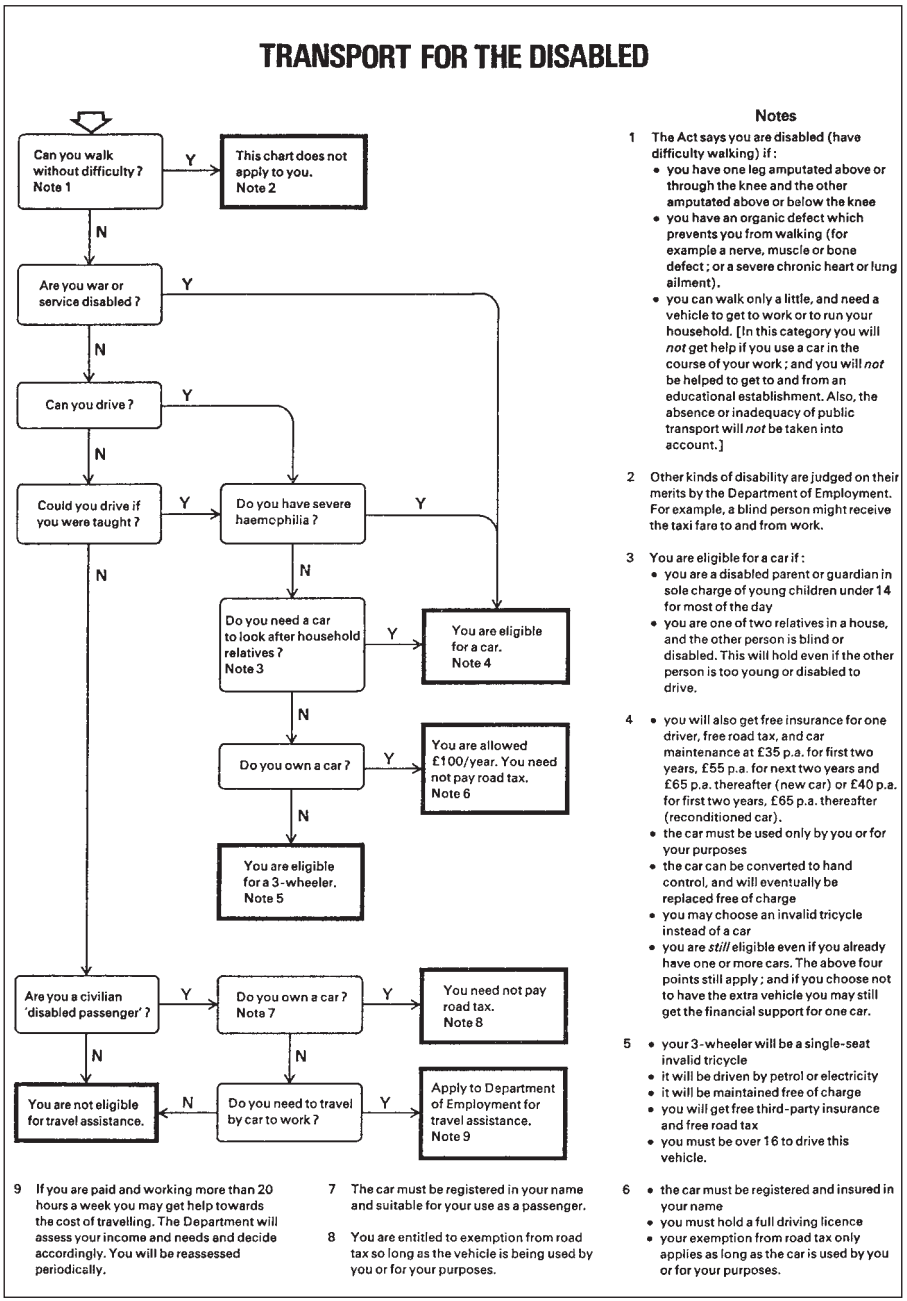
- language. Most readers simply cannot understand long, complex sentences packed with conditional clauses – read a few boxes and see!
- logic. The logical structure 'Are you A or B or C or D?'is ambiguous – what is the reader saying 'Yes' or 'No' to?
- graphics.Where to look for the next step? That is quite a problem here.



The new version on the next page makes these changes:

- supplementary information removed to notes
- one question at a time
- simple language, addressing the reader directly
- logic clarified
- graphic flow simple and predictable: outcome boxes denoted by heavy border, No and Yes in consistent direction, number of boxes minimised and length of connecting lines kept as short as possible.

This is only one way of doing it. It may well not be perfect but, as your own eyes tell you. it is a huge improvement on the first version. Twelve drafts and several long phone-calls lay between the first and last versions.


TRANSPORT FOR THE DISABLED
Can you walk without difficulty? Note 1
Y
This chart does not apply to you. Note 2
N
Are you war or service disabled?
Y
N
Can you drive?
Y
N
Could you drive if you were taught?
Y
Do you have severe haemophilia?
Y
N
N
Do you need a car to look after household relatives? Note 3
Y
You are eligible for a car. Note 4
N
Do you own a car?
Y
You are allowed £100/year. You need not pay road tax. Note 6
N
You are eligible for a 3-wheeler. Note 5
Are you a civilian 'disabled passenger'?
Y
Do you own a car? Note 7
Y
You need not pay road tax. Note 8
N
N
You are not eligible for travel assistance.
N
Do you need to travel by car to work?
Y
Apply to Department of Employment for travel assistance. Note 9
Notes
1 The Act says you are disabled (have difficulty walking) if:
• you have one leg amputated above or through the knee and the other amputated above or below the knee
• you have an organic defect which prevents you from walking (for example a nerve, muscle or bone defect; or a severe chronic heart or lung ailment).
• you can walk only a little, and need a vehicle to get to work or to run your household. [In this category you will *not* get help if you use a car in the course of your work; and you will *not* be helped to get to and from an educational establishment. Also, the absence or inadequacy of public transport will *not* be taken into account.]
2 Other kinds of disability are judged on their merits by the Department of Employment. For example, a blind person might receive the taxi fare to and from work.
3 You are eligible for a car if:
• you are a disabled parent or guardian in sole charge of young children under 14 for most of the day
• you are one of two relatives in a house, and the other person is blind or disabled. This will hold even if the other person is too young or disabled to drive.
4 • you will also get free insurance for one driver, free road tax, and car maintenance at £35 p.a. for first two years, £55 p.a. for next two years and £65 p.a. thereafter (new car) or £40 p.a. for first two years, £65 p.a. thereafter (reconditioned car).
• the car must be used only by you or for your purposes
• the car can be converted to hand control, and will eventually be replaced free of charge
• you may choose an invalid tricycle instead of a car
• you are *still* eligible even if you already have one or more cars. The above four points still apply; and if you choose not to have the extra vehicle you may still get the financial support for one car.
5 • your 3-wheeler will be a single-seat invalid tricycle
• it will be driven by petrol or electricity
• it will be maintained free of charge
• you will get free third-party insurance and free road tax
• you must be over 16 to drive this vehicle.
6 • the car must be registered and insured in your name
• you must hold a full driving licence
• your exemption from road tax only applies as long as the car is used by you or for your purposes.
7 The car must be registered in your name and suitable for your use as a passenger.
8 You are entitled to exemption from road tax so long as the vehicle is being used by you or for your purposes.
9 If you are paid and working more than 20 hours a week you may get help towards the cost of travelling. The Department will assess your income and needs and decide accordingly. You will be reassessed periodically.

Our charts give as little detail as possible. In this they are the opposite of a naturalistic picture, and especially of a photograph ... It is certainly not necessary for a chart to be poor in details, but all details must have teaching-value.
Otto Neurath, 1936

Action

If you want the reader to do something after reading the text then these points are crucial. We assume that what the readers should do is already decided (by task analysis or whatever); now we want to know if the text enables them to perform. The three key questions are: will they understand what you are asking them to do? Can they actually do it? (is it physically and psychologically possible?). Will they know when they have completed the task successfully? The simple Highway Code* rule, 'RED means stop', meets all three criteria simultaneously in three words. But what about 'at 70 mph shortest stopping distance is 70 ft thinking distance +245 ft braking distance = overall stopping distance 315 ft'? This is useless information. In the first place the accuracy is spurious, as the Code admits (wet and slippery roads, different vehicles, poor brakes and tyres, tired drivers ...). But in any event, how on earth are drivers meant to translate those numbers into appropriate action on the road? The answer is, they can't and they don't! Good drivers may learn to judge stopping distance reasonably well, but no thanks to the Highway Code for that. The infamous Green Cross Code is another case in point, so complex linguistically and logically that the young children it is meant for cannot grasp and use it with any facility.

* The Highway Code is a UK government publication for drivers that encapsulates the law and good practice. The Green Cross Code, mentioned later, contains road safety information for children.

Organisers and signposts

The army saying goes: 'First I tells them what I'm going to tell them; then I tells them; then I tells them what I've told them!' People do need to know where they are, where they are going and what the prospective pay-off is. As you proceed they need to know what the status of the message is. Are you giving them main or subsidiary information? Are you asking a question or giving an instruction? The form of the message must show its status and function. Texts are full of devices which help the reader find his way around: objectives, prefaces, introductions, contents lists, headings, questions, instructions, numbering systems, glossaries and indices are typical examples. If the communication aims at specific goals then the organisers are strongly directive (objectives, instructions); if the reader is allowed more freedom then the permission-giving organisers become more important (contents, headings). Thus the choice and emphasis depends on the purpose of the communication and the situation of the reader. Organisers are not isolated bits and pieces; they must fit together. The contents page, glossary, index, numbering system, headings, diagrams and main text are mutually interdependent; what you do in one place affects all the others. The design and layout of a two-page spread can become a little cameo of transformation; all kinds of informed guesses are made about reading behaviour so that readers can best access the information they need.

Feedback

Since you cannot be there to answer questions, readers may often wonder whether they have understood you properly. So you must allow them to check their understanding by giving them feedback. You must tell them how to recognise when they have executed an instruction or answered a question correctly or under-

stood a key idea. The feedback should take care of the most frequent kinds of mistake and should be placed immediately after the stimulus (question, instruction or whatever). It is worth mentioning that feedback can be quite subtle, for example repeating the same idea in different form gives the reader a second map-bearing which checks their first interpretation. 'Of making many books there is no end; and much study is weariness of the flesh' (Ecclesiastes 12.12).

Testing

The transformer cannot get everything right; you will be lucky to get things half-right at first. Yet the final version may need to be very good indeed if it is to succeed. How do we face this problem? We say there is a time for guessing and a time for testing. The testing should be done during the transforming process on a rough but complete draft version. The object is (obviously) to gauge whether the purpose of the communication is being achieved, and to identify and collect sources of misunderstanding. Any text which is important enough to have money spent on it is important enough to be tested, and the transforming process must allow time for the lessons learned to be put into effect.

The later stages

Earlier we saw how the transformer worked with the expert source; now we see them working with two quite different kinds of person – the skilled craftsman (or technician) and the research worker. We deal here in less detail than earlier, though in the long run the transformers' relations with craftsmen and researchers will be just as important as their relations with sources.

Production

Transformers depends upon illustrators, photographers, compositors, film editors and other skilled people to help him realise their vision. They can make a real contribution. At their best they can teach the transformer a good deal about the possibilities and limits of their arts, and about the costs and implications of various production methods. In some cases (scientific photography, for example) a skilled operator can help the growth of the subject-matter as well as its subsequent presentation. The transformer should deal with these specialists in person, not through any kind of intermediary. Without the transformer the final product often reflects the production process rather than the needs of the reader. How often have we seen the fussy house-style applied unintelligently, or the diagram which has lost its meaning because the illustrator did not understand it! Often a freehand sketch by someone who understands works better than it does when redrawn 'professionally' by an illustrator.
The last decade has brought us strike-on composition, dry transfer lettering and simplified photo-litho processes; modern print methods such as these cut out many of the old constraints and mysteries of printing. Underground papers take advantage of those new techniques to bring the communicator closer to the reader. We should think long and hard about such ideas.

Where is the argument? Traditional visual material, often marvellously presented, does not always reckon with this essential point. The life and habits of an animal may be shown in a film, but if we ask why certain features were presented, the answer is frequently quite inadequate. It may merely be that the photographer saw the chance of a good or amusing shot. That may be excellent entertainment, but - where is the argument?
Otto Neurath' 1944

Evaluation

'Discovering the effects' is the last part of the transforming cycle. This means going out into the field and looking at all the consequences of the communication that can be found. The really gross errors should be picked up earlier in developmental testing, but many subtle effects only show up later in the field. The information gained can be used for subsequent editions, but is in any event useful since similar problems and situations are just bound to occur. Transformation is an active process that learns, not a passive dispensing of recipes. Evaluation can be a complex technical matter. Unless the transformer has research training they may well need the services of a professional researcher to them to ways of collecting data. The budget for evaluation depends on the cost and importance of the communication and the prospects of similar publications in the future: we do suggest that there should always be such an item in the budget.

Recurrent problems

As time goes on the transformer will notice certain problems coming up time after time. Sometimes they cannot be solved simply or intuitively; they need detailed work in depth for a long time. This is the job of the basic researcher, who may well be in-house if the institution is large enough. The relationship between these two colleagues is often uneasy, with the transformer wanting solutions yesterday and the researcher limited by what it is possible to do, given present knowledge and resources. A similar case is the relation between general practitioners and medical researchers. The GP has patients now in the surgery, but the researcher knows that some questions just do not have easy answers. For all that, the art of medicine advances by this mixture of co-operation and conflict, and so should the art of transforming.

Finale

Our message is humanistic: break down the barriers in the interests of the reader. Take responsibility for the success or failure of the communication. Do not accept a label or a slot on a production line. Be a complete human being with moral and intellectual integrity and thoroughgoing technical competence. Be a transformer!

He who knows best what to omit is the best teacher, and he who can omit nothing should not be a teacher at all ... The Vienna school postulates: *to remember simplified pictures is better than to forget accurate figures*.

Otto Neurath, 1925

2000 Postscript RW

The *Penrose Annual* (subtitle: 'the international review of the graphic arts') was published from the 1890s to the early 1980s. It started as a showcase for printers and manufacturers of printing equipment, but it soon covered other aspects of printing's cultural context, including typography, illustration, and printing history. The 1976 volume, in which 'The transformer' appeared, included not only articles of obvious interest to printers (about imaging science and photosetting), but also mapmaking, postage stamp design, private presses, magazine design in Poland and corporate identity.

When this paper was written I was a recent recruit to the Textual Communication Research Group (TCRG), set up by Michael Macdonald-Ross, which operated from the mid seventies until the mid nineties. A graduate of the typography course at the University of Reading, I joined a group that soon included a cognitive psychologist, an information scientist and a linguist (although he did not stay long, and that side of the work was not supported by a specialist). Michael Macdonald-Ross's background was originally in zoology, and subsequently training technologies, and he had been one of the consultants employed to help set up the Open University. The group's goal was to draw together whatever useful approaches it could find in order to inform the development of better distance education materials.

The group was part of a general coming together of graphic design with its neighbouring disciplines.Other programmes in the UK included Herbert Spencer's group at the Royal College of Art, the work of James Hartley and Peter Burnhill, and Michael Twyman's curriculum at the University of Reading. And although it was not multi-disciplinary in the same way, any account of the period should mention the immense contribution of Patricia Wright and others at the Applied Psychology Unit in Cambridge.

Michael Macdonald-Ross's major contribution to this process was to draw links with a much wider range of approaches and disciplines than most designers were previously aware of. There had long been links between psychologists and designers, but at TCRG we were exposed to other fields and sub-disciplines such as content analysis, task analysis, bibliography, taxonomy, cybernetics, theories of learning, and instructional design.

The Institute of which we were part had the job of helping academic specialists communicate clearly to students studying at home. So Otto Neurath's transformer role was an obvious model for us to adopt. And when we were asked to contribute an article to Penrose Annual, it seemed a good opportunity to develop our own interpretation of the role.

Twenty-five years on, many of the points made here continue to be relevant and are worth debating again. Reading it again after many years, I was struck by the moral dimension expressed in its conclusion: 'Be a complete human being with moral and intellectual integrity and thoroughgoing technical competence. Be a transformer!'. This moral dimension has permeated information design, to the extent that some appear to see it as almost entirely an altruistic (and by implication, public sector) activity. Indeed people reporting commercial projects at information design conferences are sometimes made to feel they are prostituting their skills. This worries me: my company works for private and public sector clients and we find equal measures of integrity in each. And who thinks pensions plans, insurance policies and bank statements should not be equally as clear as government forms or educational texts?

What of the term 'transformer'? Offprints of this paper were much requested at the time, and the term was explicitly adopted in at least two organisations that we know of, although it doesn't survive today. One was the Open University's community education division, where we tried to use techniques (and processes) from journalism to help build readable, effective courses on parenting, health, and similar topics. The Open University's School of Business also used the transformer method in some courses. Transformers were also appointed at the Natural History Museum in London, which in the late seventies moved away from specimens in glass cases in favour of interactive experiences.

Although the article talks of the transformer as a single person, we were also describing a process, and perhaps a team. We used to debate this and I think that over the years, Michael and I have probably reversed positions. He used to argue strongly that only a single individual could keep track of the different facets of a particular job, whereas I used to think it impossible for a single person to have all the skills and qualities to be a transformer – understanding the content as well as the design, challenging the expert's motives, standing up for the reader, overseeing production. But now I think it equally challenging for a team or institutionalised process to do these things effectively. Good transforming is often done instinctively and quickly, but teams require issues to be articulated and minuted. And the reality of deadlines and budgets mean this hardly ever happens.

At Information Design Unit we recruit people to be designers or writers. But the designers think about the words, and often write, and the writers use layout as an integral part of their writing. We don't expect people to completely cross over, but it is always our hope that people will not stay entirely in the specialist role assigned to them but will 'break down the barriers in the interests of the reader...' and 'take responsibility for the success or failure of the communication.' In other words, to be transformers.

Robert Waller

Postscript MM-R

Our article on the transformer certainly raised issues – probably far too many! How influential was it? Hard to say. We probably struck chords in readers who were already aware that traditional roles such as designer and editor tended to divide a process which required integrity.

The question as to how a person can develop the skills needed to be a transformer is crucial, yet hard to answer. There is no completely satisfactory kind of education yet available, and much of what we learnt was through our own efforts. There is no end to the ways in which people come to understand ideas, and so there's no end to the need for transformers to grow as communicators. In addition to linguistic and graphic skills, the capacity to think and analyse is highly important. Looking back I can see how the lack of some kind of standard education and training (and the lack of a personnel category for transforming) has been an obstacle to inserting our ideas into large institutions.

The article, written in our optimistic youth, scarcely touched the world of committees and organisations, and imagined the transformer to be a polymathic individual who had a kind of over-riding control of the communication. Well, frankly, one is rarely in such a privileged position! The tendency for large organisations to work by committee is certainly a great obstacle to clarity and unity of purpose. Despite its limitations, the article made some kind of a splash in its time and contained some acute observations and examples. It was indeed stimulated by our work in the British Open University, which set out to deliver quality distance education with a minimum of face-to-face contact. Since the OU succeeded (when so many expected it to fail) I might claim our ideas were right on target. But I won't make any such claim. The OU works because the students make it work. Perhaps the essence is to get people to think about their message from the viewpoint of the recipients.

Michael Macdonald-Ross

The Isotype chart in 'The Transformer'

There is a story behind the Isotype chart we included in this paper. One of the few psychological studies to address the effectiveness of Isotype charts was Vernon (1946). Figure 2 shows the chart she used in her tests, described by her as an Isotype. It takes the table we showed in 'The transformer', and simply substitutes symbols for numbers, in centred columns that prevent the eye from making simple comparisons. Not surprisingly, she found that the chart was less effective than a simple line graph.

We felt that this study did a huge injustice to Isotype, failing as it does to represent either the graphic quality of real Isotypes, or the quality of graphic argument that the Neuraths routinely built in to their work. This might not have mattered, but the study is also featured in Vernon's very popular textbook *The Psychology of Perception* (1962).

We traced the original government statistics used by Vernon, and approached Marie Neurath, at that time retired but still working in London, to design a chart from the same data. Figure 3 was the result, and we repeat it here for easier comparison. She simplified the data and used a cohort of symbols moving across the chart to show the main argument – that during wartime, the work force shifted from less essential industries to the armed forces and war-related industries. We tested the result successfully, although did not publish the results – but we think the charts speak for themselves.

Neurath's chart illustrates both the strengths and the limitation of the Isotype approach. The visual argument takes precedent over all else. Because only three years' data are needed to show it, the other years are omitted. Because she wants us to *see* (not just to understand) the way that employment shifted, she forces the divisions between employment types to move. So if the argument were different, an entirely different chart would be required. It is quite possible, then that the equivalent statistics from another era would be presented in a way that would not be comparable with these. The transformer is not just presenting the statistics, but telling us what to think. So there is a thin line between Isotype and other kinds of distortions we are used to criticising in statistical presentations (for example, the use of inappropriate scales to flatten or exaggerate trends).

The key issue for me is whether the reader knows the status of a chart – Isotypes do claim objectivity and a statistical base, but because they discard the scientist's white coat they make their status clear to the reader, and invite critical engagement. They are clearly arguments, not primary data.

NUMBER OF MALES AGED 14-64 IN GREAT BRITAIN

TABLE 1 — Thousands

Mid-year	Armed Forces (1)	Whole-time Civil Defence	Industrial groups			Unemployed	Rest of male population (5)	Total male population aged 14–64
			Group I (2)	Group II (3)	Group III (4)			
1939 ...	477	80	2,600	4,688	5,798	1,043	1,324	16,010
1941 ...	3,271	324	3,140	4,264	4,116	158	704	15,977
1942 ...	3,785	304	3,285	4,154	3,553	103	750	15,934
1943 ...	4,284	253	3,305	4,040	3,093	76	870	15,921
1944 ...	4,502	225	3,210	4,059	2,900	71	943	15,910

(1) These figures, and also the total column, exclude prisoners and missing.
(2) Munitions industries, i.e., iron and steel, non-ferrous metals, shipbuilding, engineering, aircraft and vehicles, instruments, chemicals, explosives, etc.
(3) Agriculture, mining, National and Local Government, transport, shipping (including Merchant Navy), public utilities, food manufacture.
(4) Building, textiles, clothing, distribution, professional services, etc.
(5) Schoolboys, students, invalids (including war invalids), retired, etc.

Figure 1. The government statistics used as the basis of Vernon's 'Isotype' chart.

Vernon, M.D. (1946) Learning from graphical material. *British Journal of Psychology*, 36: 145
Vernon, M.D. (1962) *The Psychology of Perception.* London: Penguin

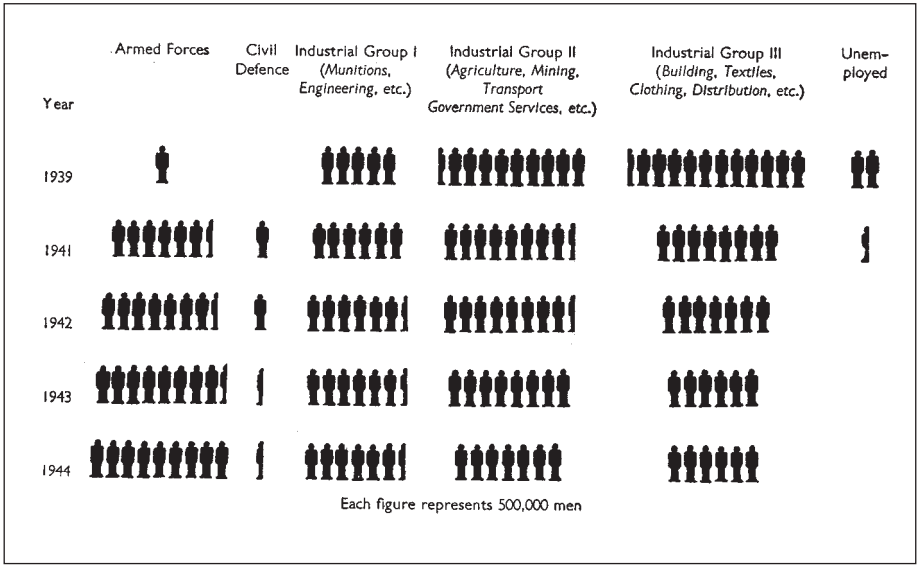


Figure 1, reproduced from Vernon (1962). The caption, which was not an integral part of the chart, read 'Chart showing number of men aged 16-64 years in various occupations'.

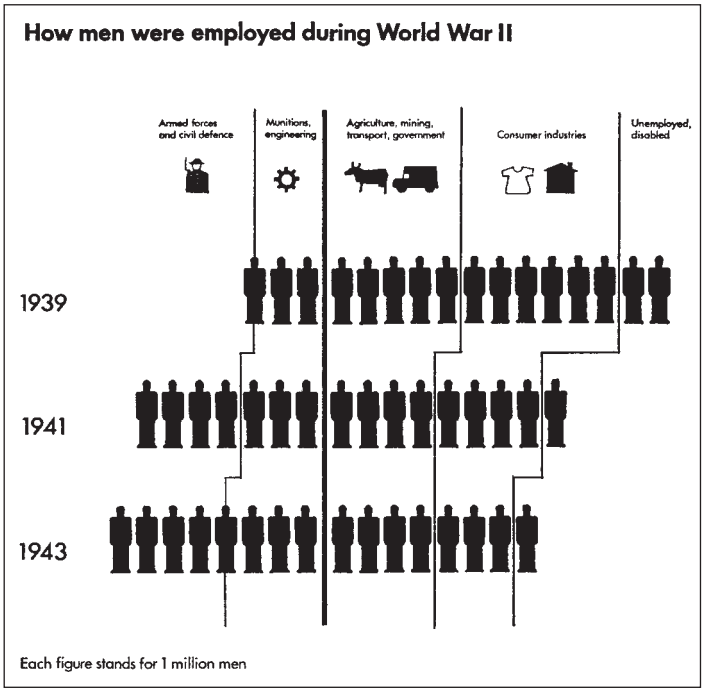


Figure 2. The same data diagrammed by Marie Neurath of the Isotype Institute.

Some things to note:

- language is considered alongside design – the large simple caption defines the context in the chart is read
- each figure represents 1 million men – not 500,000. Isotype charts normally use a scale of 1:10, 1:100 etc in order to make interpretation easier
- the word 'Year' omitted because it is unnecessary – what else would 1939 be in the context of World War II?
- only three years' data are needed to show the argument, so the rest is edited out.