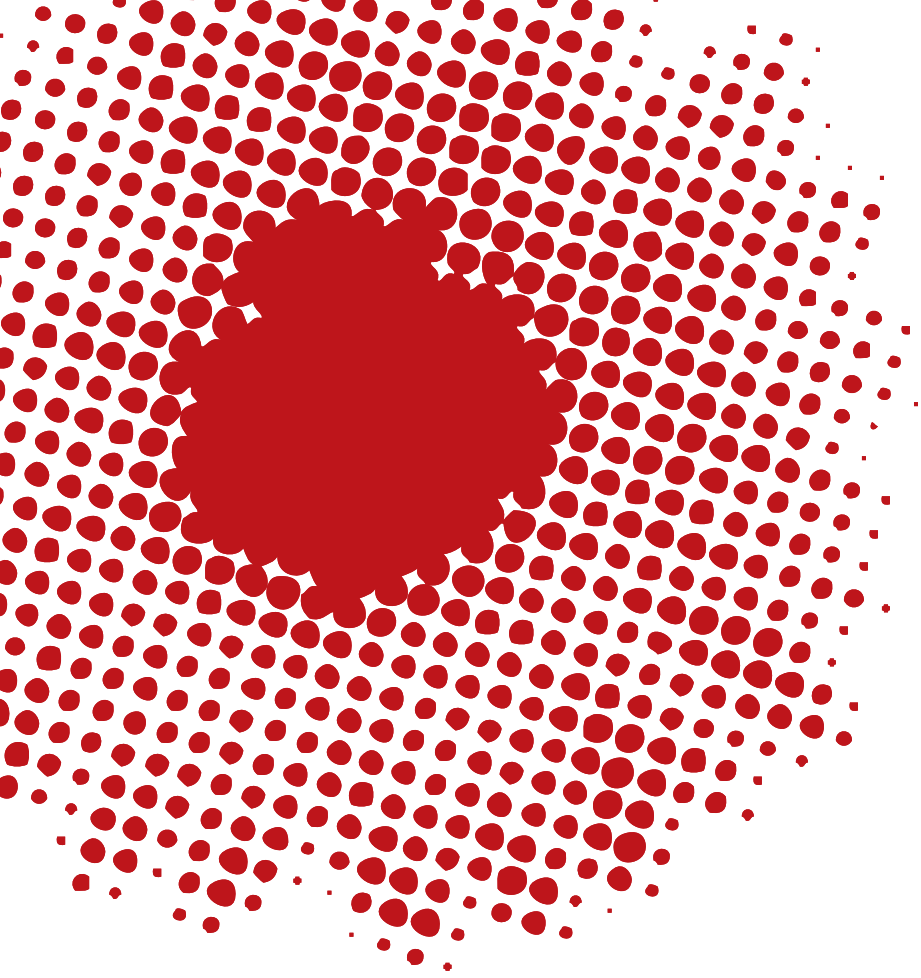

DESIGNS FOR LEARNING

#1-2/10

Changing Text: A Social Semiotic Analysis of Textbooks

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In this paper we provide a multimodal account of historical changes in secondary school textbooks in England and their social significance. Adopting a social semiotic approach to text and text making we review learning resources across core subjects of the English national curriculum, English, Science and Mathematics. Comparing textbooks from the 1930s, 1980s and 2000s, we show that a) all modes operating in textbooks -typography, image, writing and layout- contribute to meaning and potential for learning b) that the use of these modes has changed between 1930 and now, in ways significant for social relations between and across makers and users of textbooks. Designers and readers / learners now take responsibility for coherence, which was previously the exclusive domain of authors. Where previously reading paths were fixed by makers it may now be left to learners to establish these according to their interests. For users of textbooks the changes in design demand new forms of 'literacy'; a fluency not only in 'reading' writing, image, typography and layout jointly, but in the overall design of learning environments. We place these changes against the backdrop of wider social changes and features of the contemporary media landscape, recognizing a shift from stability, canonicity and vertical power structures to 'horizontal', more open, participatory relations in the production of knowledge.

INTRODUCTION

The contemporary semiotic world poses sharp questions about text. Increasingly text makers draw on several *modes of representation* and in many texts writing is not the central means for making meaning. The multimodality of texts is intimately connected with profound changes in the social relations between those who make and those who engage with text. Where previously these relations centred on relatively stable notions of 'author' and 'reader' they now involve a wide and diversified range of meaning makers and modal resources. The writing of Authors sits alongside the images provided by Visual Artists and the layout of the Graphic Designer. Through each of these modes a multiplicity of readers is drawn into text. Guided by their own interests they navigate their way through the 'stuff' that was selected, highlighted and arranged for them. In this article we provide a social semiotic account of these social changes through a multimodal analysis of text circulating in the domain of education. We review textbooks across core subjects of the national curriculum in England - English, Science and Mathematics - focusing on how the various professionals involved in this medium use their distinctive expressive resources

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to project their notions of 'learners' and shape their engagement with the subject. We compare (writing-led) textbooks from 1930s and 1980s with contemporary (visually-led) textbooks, exploring the social and pedagogic implications of the shift from written to multimodal text. We analyze these shifts in text and text making against the background of social changes in power and in principles and agencies of control.

CHANGING TEXT

Where up to two decades ago maybe, competence in relation to one mode, *writing*, was seen as sufficient for the task of *composition* of text, we now need to understand the semiotic potentials of all modes involved in the design and making of multimodal text. Now, when text consists of image and writing say, specific forms of textual cohesion and coherence emerge and theoretical means are needed for making sense of these. Where previously grooved routines of convention could serve as reliable guides in composition, in a multimodal world there is a need to assess on each occasion of text-making what the social relations with an audience are, what resources there are for making the text, what media are going to be used, and how these fit with what is to be communicated and with a clear understanding of the characteristics of the audience. Hence a rhetorical approach to text-making is essential.

The shift from composition to design points to current changes in *power* and in *principles* and agencies of *control* which are – among others - about a shift from 'vertical' to 'horizontal' social structures, from hierarchical to more open, participatory relations. This has effects such as the disintegration of former social frames, leading to changes in *genres*, in access to and notions of authorship and canonicity. This wholesale change in social relations means that participation in *semiotic production* now describes the characteristics of communication more accurately. With former structures of power, the characterization of the relation of 'audience' to 'author' had been that of 'consumption'. With new distributions of power, production and participation are the ruling dispositions of those who had previously been seen as 'audience'. Youtube can stand as a metaphor for the changed social relation to media: *producing* for an unknown and potentially vast group, *distribution* via existing, new or yet to be created 'sites': production for the new media, new sites, in full 'democratic' (?) *participation*.

All aspects of text-making are drawn into that, with far-reaching effects. In many contemporary social practices there seems little or no concern about what were, until the mid-eighties or so, central questions, for instance questions of 'authenticity' of authorship of certain kinds of texts. In *downloading, 'mixing', cutting and pasting, 'sampling', re-contextualization*, questions such as "where did this come from?" "who is the original/originating author" seem not an issue. Much like the use, in former times, of a ruined castle or monastic building as a quarry, a source of building materials – a large chunk here as a lintel, another there as part of a wall - texts are taken as 'resources' to be 'mined' for

the making of new texts. There is an absolute need to understand the practices, aesthetics, ethics and epistemologies of contemporary forms of text production. At the moment these are discussed in terms of 19th century models, where terms such as 'plagiarism' or 'mere copying' are too often too readily to hand: that is, the invocation of models from an era where conceptions of authorship were clear and legally buttressed.

CHANGING TEXT IN EDUCATION

Educationists have become acutely aware that school subjects draw on a range of modes of representation and communication. Curriculum and pedagogy are articulated in the architecture of classrooms, in the embodied action of teacher and students (Kress et al., 2001; 2005), in images such as diagrams, photographs, and drawings (Myers, 1990; O'Halloran, 2005; Kress & van Leeuwen, 2006), in moving images such as animations (Jewitt, 2006), in objects such as 3D artifacts (Leander, 2002), and a range of other semiotic resources. These observations have put notions of 'literacy' as 'language demands of the curriculum' into a new perspective. It is not only language that learners need to grapple with, but a set of multimodal resources for making meaning (New London Group, 1996; Lemke, 2000; Cope & Kalantzis, 2009).

Over the last 75 years or so, profound changes have taken place in the use of these resources. Teachers and designers of learning resources have always drawn on a range of different 'modes' - writing and image foremost among them, yet new technologies have given rise to the possibilities for an increase in the use of more modes than these and in 'ensembles' of modes. While images had featured in textbooks in that earlier period, now not only do there seem to be more images than before, they often seem to dominate the page. In a different set of media, the shift from the blackboard to the interactive whiteboard has led to an increase in the use of visual means for the presentation of science and other subjects (Jewitt, 2006).

Growing concerns have been expressed about perceived changes in the 'look' of textbooks, such as the increased use of images, and their implications for learning. To some observers this threatens literacy, must lead to a general 'dumbing down' and is bound to have deleterious effects on economic performance. Less prominent, if equally firmly expressed, are beliefs in the empowering potential of such changes by their offering new routes into existing curriculum topics (Kaplan, 1995). In this paper we aim to investigate text and text making from a social semiotic perspective, which amongst other assumptions implies that we treat 'image', 'writing' and other modes of communication as distinctly different yet equally potential resources. We acknowledge that cultures and societies recognize these resources to different degrees, privileging one above the other, or treating one as 'richer', 'better', or aesthetically more attractive than the other, not dissimilar to the social and cultural privileging of different languages, for instance English versus Panjabi in multilingual London. Social semiotics assumes that power relations are

manifest in the recognition of modes, and sets out to investigate how people use and continue to develop modes of communication in response to social and cultural demands.

TEXT AS SEMIOTIC WORK

A social semiotic approach to text places multimodality at the centre of attention (Bezemer & Kress, 2008). It ascribes meaning to all modes of communication, including image, writing, typography and layout; and it treats signs of any kind as reflecting the interests of the makers of these signs – here, curriculum planners, textbook designers, teachers. In each of the modes *semiotic work* – attending, engaging, transforming, integrating, ordering - is done by makers and users of textbooks. In one mode more semiotic work is to be done by the reader (the layout of a modular text, say), in another, simultaneously present mode, more work has been done for the reader by the designer (in continuous segments of writing, say). Text design is based on such 'division of labour', and only by looking at the entire, multimodal design can we reconstruct these complex social relations.

Producers are regarded as *sign-makers* as are users of text, and, in that, both are seen as *meaning-makers*. Signs are elements in which meaning and form have been brought together in a relation motivated by the interest of the sign-maker. A sign made by a textbook 'producer'/'maker'/designer' is *re-made* ('interpreted') by a 'user'/'reader' (who may or may not represent the imagined audience of the textbook maker). Sign-making is always subject to the availability of semiotic resources and to the aptness of the resources to the meanings which the sign-maker wishes to realize. In principle, limitations of resources apply always and everywhere, even if not with the same severity: in many classrooms around the world there exist the severest constraints on resources both for teachers and children. Nevertheless, the design of a text is treated by us as the sign-maker's apt representation of her or his interest, given the resources available in the circumstances which prevail. This means that the signs made by the textbook 'makers' are never exact replicas when they are re-made by its 'users'. This points to a significant difference between our social semiotic theory of communication and theories which assume that 'messages' are 'encoded', 'transferred' and then 'decoded'.

The interest of the producer of the texts at issue here is pedagogical. Pedagogical interest responds to the question "what is my preferred social relation with my imagined audience and how can I best realise it?"; "how is the subject content best shaped and realized to represent my *theoretical conception* of the subject while maximising the learner's engagement?" The producer's as well as the audience's interests are shaped by the social, cultural, economic, political and technological environments in which signs are made; the design is the result of the interaction between all of these. At the same time sign-makers have to be aware of the *media* of distribution for their signs, and that awareness is factored into the making of the sign.

Signs are made using the resources of *modes*. A mode is a set of socially and culturally shaped resources for making meaning. Modes can be used to represent what the world is like, how people are socially related and how semiotic entities are connected (Kress, 2009). *Image, writing, layout, colour* and *typography* are examples of *modes* used in (contemporary) textbooks. Modes offer differing representational resources. Writing for instance, has syntactic, grammatical and lexical as well as typographical resources such as type size, font and letter fit. *Speech* and *writing* share certain aspects of *grammar, syntax* and *lexis*. Beyond these, *speech* has resources of intonation for instance, of loudness, length, tone of voice. *Image* has resources such as pictorial detail, size, colour, and shape. These different resources can be used to do different kinds of semiotic work; or to do broadly similar semiotic work through the differential use of (elements of) resources. Modes, that is, have different material origins which have been shaped, over time, by cultures to 'mean'. This enables sign-makers to do different semiotic work in relation to their interests and their rhetorical intentions for designs of meaning; which, in modal ensembles, best meet the rhetor's interest and sense of the needs of the audience. That is, by drawing on the specific affordances of different modes in the making of complex signs as modal ensembles, sign-makers can meet the complex, often contradictory demands of their own interest, the needs of the matter to be communicated and the characteristics of the audience.

Given the complex relation of modal affordance, rhetor's interest and the variability and complexity of social environments, *design* moves into the centre of attention. We use the term 'designer' metonymically to refer to all those involved in the production of the textbook. In each of the modes semiotic work is done by the makers of the text - including authors, illustrators and graphic designers - as by the users of the text, including –in the case of textbooks- 'learners' and 'teachers'. The multiplicity of modes offers the designers a potential multiplicity of epistemological positions; the multimodality of textbook-design allows textbook makers to 'mix' different theories of learning in one text: in one mode the semiotic work to be done may draw more upon the learner, while in another, simultaneously operating mode, more work may be done for the reader by the textbook maker. In other words, one mode (*writing*, say, in the *genre of procedure*) may suggest a 'transmission' model of teaching and learning, another mode (*image*, say, in the *genre of concept map*) may suggest 'collaboration' and a 'constructivist' of learning and teaching; one may suggest learning based on induction, the other mode may suggest learning based on deduction. We can often see a mixture of such models articulated within one and the same textbook. These mixtures may be deliberate attempts to synthesize different notions of learning for an increasingly diverse audience. They may also be the outcome of a less than carefully concerted effort to produce textbooks based on a shared understanding of learning.

ANALYZING TEXTBOOKS

We reviewed 92 excerpts from 59 textbooks for English, Science and Mathematics, published in the 1930s, 1980s and 2000s, totalling 700 pages. These were randomly chosen from card and electronic catalogues of the library of the Institute of Education, University of London, the largest collection of textbooks in England. For reasons of comparability, each subject was represented by a 'stable' curricular issue across that period. In English, this was *Poetry*, in Science *Digestion and Electric circuits*, in Mathematics *Angles and Fractions*. We indexed, digitized and saved all excerpts as PDF-documents to enhance our analysis and future use of the data base by third parties. Table 1 details the number of textbooks, textbook excerpts and pages in the data set by subject.

N	Textbooks	Excerpts	Pages
English	23	29	240
Science	19	31	276
Mathematics	17	32	187
TOTAL:	59	92	703

Table 1: Data set by number of textbooks, excerpts and pages

For each combination of 'era' (1930s, 1980s, 2000s) and subject (English, Science, Mathematics) we made an initial selection of 8 to 12 excerpts. We derived four subsets from the corpus, covering image-representations of the digestive system and of electric circuits, poems, and angles. Informally, we collected 6 textbooks for secondary education from Germany, the Netherlands, Hong Kong, Japan and Brazil. We reviewed 16 electronic learning resources, addressing topics from the National Curriculum for English, Science and Mathematics.

We developed an analytical framework in which Social Semiotics provides an overall integrating theory, and analytic means, notably for the description and analysis of image; Discourse Analysis, notably for writing; and Graphic Design, notably for typography and layout. It assumes that conditions for learning are shaped by every sign in every mode operating in a textbook. For *image*, we analysed 'contextualisation', 'colour', 'pictorial detail', 'illumination', 'depth' and 'movement' (Kress & van Leeuwen, 2006). For *writing* we looked at mood and clause relations, drawing on Halliday (1985), Hodge & Kress (1988) and Fairclough (2003); for *typography*, we drew on Stöckl's (2005) 'toolkit' for analyzing type and resources such as spacing, orientation, indentation and typographic emphasis. Lastly, we focused on the layout of pages: attending to page format and grid, number of columns per page, column width, and orientation and alignment of page elements (Ambrose & Harris, 2005; Haslam, 2006).

In this paper, we discuss the changes we found in writing, image, typography and layout in separate sections. We use examples from science textbooks to discuss changes in writing and image; and English textbooks to discuss changes in typography and layout. This is a presentational selection: our analyses suggest that we could have turned the matching of these modes and subjects around, and still be able to make the same claims (see e.g. Bezemer & Kress, 2009 for English examples of changes in writing and image).

WRITING

Syntactic complexity is often equated with cognitive complexity: the more complex the sentence structures are, the higher the cognitive demands of the text, making it more or less 'apt' for certain imagined 'ability groups'. We argue against this equation, and suggest that the questions ought to be: 'What kinds of complexity are there; where do these lie; what are the features and characteristics of 'complexity'?' and 'What kinds of semiotic work are being done, by an for whom?' To address these questions we will now discuss three aspects of writing: number of clauses per sentence, clause relations and argumentation. We focus on three excerpts from Science textbooks in which series and parallel circuits are compared (Field, 1937; Hill & Holman, 1986; Chapman & Sheehan, 2003). The excerpts can be found in the Appendix.

In the excerpt from Field (1937), the average number of clauses per sentence is 3.2, with a high of 7 clauses per sentence. The types of clause-relation within sentences are a mixture of paratactic relations – that is, clauses as relatively equal, much as beads in a chain; and of hypotactic relations, unequal relations, hierarchical, with relations of super- and sub-ordinate. The form of argumentation in the paragraph is predominantly hypothetical and conditional: the genre is that of 'scientific hypothesis'. Image is mentioned at the end only; as a kind of visual 'underpinning' of an argument already made verbally. Writing is clearly 'prior', as the significant mode. Were we interested in the issue of 'scientificness' and of 'scientific writing', we might mention the frequency, dominance even, of agentless passives; in the 11 sentences there are 12 passive clauses: *are* joined *together, wires being* taken, *they are* said, *joined* in series, *are* joined *together, were joined, leads being taken*, the joined *positives*, the joined *negative*, are said, joined *in parallel*, joined *in series*.

In the 10 sentences in the excerpt from Hill & Holman (1986), the average number of clauses per sentence is 2. There is one sentence with 3 clauses. The clause relations within sentences tend to be a mix of paratactic and hypotactic; the form of 'argumentation' is 'factual' rather than 'hypothetical'. The genre is that of *report*; though a report with an imperative form in it. There are six references to images: with an initial framing reference; an instruction / command to "look closely at the circuit diagram", a further reference to an image for comparison and conclusion. In the 10 sentences there are 5 agentless passives; that is, the active form predominates: *connected in series, not connected in series, is connected singly, are said, connected in parallel*. Compared to the excerpt

from the 1930s, writing has become syntactically simpler. The 'address' of the reader through the genre of report rather than that of scientific hypothesis is different. Gone are hypotheticals and conditionals. Image has become centrally significant in the communication of curricular knowledge.

The much smaller written text-element from Chapman & Sheehan (2003) (10 sentences) has 'headings' as a means of subdividing the conceptual / textual material. For the ten sentences, the average number of clauses per sentence now is 1.7; with a high of 3 clauses in one sentence. The dominant form of clause connection is paratactic (with, possibly, depending on one's theory of grammar, two instances of hypotaxis). In this written piece of text, there is direct address of the reader: in the command "look at", and the slightly implicit command (twice) "you can". The form of 'argumentation' is factual; the genre is a mix of *instruction* and *report*: declarative sentences dominate. There is one agentless passive clause. There are six, possibly seven, references to images, with an initial framing "as shown here" and the command "look at"; and a concluding / summing / ratifying "the diagram shows".

We can make some instructive comparisons of the changes in written elements: a) complex sentences become radically fewer: an effect both of a significant decrease in the number of clauses per sentence and of the decline of hypotaxis; b) the passive sentence form, as an indicator of scientificness declines; instead the texts move to active voice in clauses; c) the genre changes from the *scientific hypothesis* via the report to a mix of *instruction and report*; d) there is a shift from the hypothetical to the factual and instructional. All of these are indicators of changes in 'recontextualization' (Bernstein, 1996). We might put it like this: the laboratory and its practices and forms recedes more and more in a recontextualization which emphasizes the pedagogic and curricular tasks and characteristics of the contemporary conception of the school-subject Science. In the 1930s the 'author' ordered propositions in writing, one means of producing a coherent text-as-knowledge. Now, much of the work of producing structural relations between textual elements and, in that, of producing knowledge, is done by users of the textbook. This shift in agency is tied in with contemporary allocations of agency, forms of (collaborative) authorship, themselves linked to a move away from traditional understandings of 'knowledge' (Bezemer & Kress, 2009; Kress & Bezemer, 2009).

IMAGE

Sentence complexity is often equated with cognitive complexity and used as a resource for constructing (or inferring) 'ability', and so are the resources of image. In image, as in any other mode, sign-makers make statements about the world. For instance, they show the effect of letting electric current flow through a given circuit. At the same time they use the image to suggest how 'real' the representation of that statement is; whether it should be read as an abstraction, or as a concrete instance; as imagined or real objects and processes. This 'modality' – as an indication of its 'reality status' - of an image

(Hodge & Kress, 1988; Kress & van Leeuwen, 2006) is suggested using a range of different resources. All images of the electric circuit we reviewed use at least one of the following resources to mark modality.

1) *Spatial detail:* the image may be read as accurately representing the spatial proportions of the objects (or 'components'), for instance the relative sizes of wire, light bulb and battery. In the 'canonical', 'topological' notation, the relations between objects accurately represent the *arrangement* of the circuit; the length of the lines connecting the objects do not accurately represent the actual distance between the two objects.
2) *Pictorial detail:* the objects represented in the image may be given more or less pictorial detail. In the 'canonical' notation, objects are given minimal detail: they are 'circuit symbols'.
3) *Depth:* the represented objects and their arrangement may or may not be given visual depth. This too is a continuum, and there are many different ways in which visual depth can be suggested, for instance shading, overlap, variation in size.
4) *Colour:* the represented objects and their arrangement may or may not be given (their -conventionally - typical) colour. The use of colour can be further analyzed into the features of colour saturation, colour differentiation and colour modulation.
5) *Background:* the objects which form the actual circuit may be placed in a recognizable context, for instance on a table, with a 'scientist' holding some of the objects.

Modality markers are used in ensembles and can be adjusted separately: one can create an image with a lot of pictorial detail but no depth, or with no pictorial detail but with depth. One can adjust the degree of depth, or the degree of pictorial detail. That offers an infinite variety of representations of the electric circuit to be created, each with its specific focus on what is to be given what kind or degree of realism and the degree of modality; each projecting a sense of the characteristics of its imagined audience – ability, interest, gender, and so on. Thus it is central to the recontextualisation (Bernstein, 1996; Dowling, 1998) of discourses from Science to Science Education. The abstract, topological representations used in Science are re-designed in view of an audience's imagined preferred forms of realism. Different degrees of modality are used to project conceptions of different learners: learners, for instance, assumed to be capable of dealing with various degrees of abstraction. Modality of the image operates alongside 'annotation' of the image: writing can be added to the image and connected to specific parts of the image through contiguity or leader lines. Usually the writing assigns names to the circuit symbols: 'bulb', 'wire', 'electron flow', 'voltmeter'. But it can also describe the processes represented by the image. Another means of re-contextualisation is the use of 'scenes' - environments from 'everyday life' as metaphors for electric circuits,

such as the heating circuit system or the flow of water.

For all three periods it is possible to arrange the 'realistic' images in an order reflecting the degree of modality, but there is no evidence that the realistic images from the 2000s are more realistic than the 'realistic' images from the 1980s: there is no evidence to suggest that over the period the kinds of realism used have changed. Compare for instance the following two images from the 1930s. Figure 1 uses both standard circuit symbols, for instance for 'battery' and 'switch' and more 'realistic' representations for other components, such as a bell, which is given some pictorial detail and depth. The connections between the components look more like actual wires than standard notation. Compared to Figure 1, Figure 2 uses much more pictorial detail and depth, making the circuit look more 'real'.

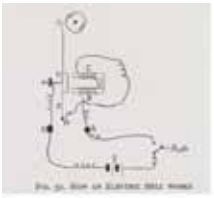

Figure 1

Figure 2

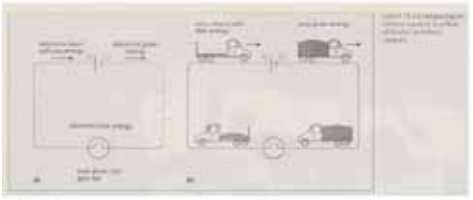

Figure 3

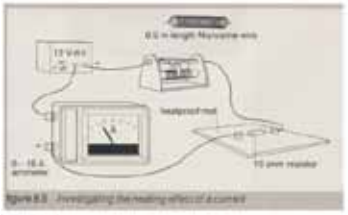

Figure 4

Figure 5

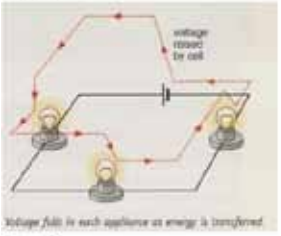

Figure 6

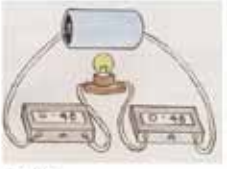

Figure 7

Figures 1-7.

Figures 3, 4 and 5 are taken from textbooks from the 1980s. Figure 3 juxtaposes two representations of circuits, combining canonical circuit symbols (battery, light bulb) with elements from everyday environments - representations of lorries - (using some pictorial detail and no depth). Figure 4 is a more 'realistic' representation; it contains no canonical circuit symbols at all, and it uses more depth than Figure 3. Figure 5 is again more realistic, having added details of the 'background' of the circuit: a table and a 'scientist'; and colour. Figures 6 and 7 are taken from the 2000s. In Figure 6 canonical circuit symbols are used in combination with more realistic representations of other components. The connections between the components suggests depth but the straight lines turn them into something more abstract than wires, such as in Figure 7, which uses no canonical circuit symbols and therefore seems more 'realistic'.

One might call the representation in Figure 3 a 'metaphor' since it signifies something which 'is like' electric current rather than something which 'is' electric current. Yet from a semiotic perspective all representations are metaphorical. Sign makers select those features of the signified which they believe are criterial and central to what they want to communicate to their imagined audience, and they select those signifiers which they believe are most apt for that audience. In the case of Figure 3, the selected features were 'movement' and 'energy', and the signifier thought to be most apt for representing that feature was an image of a lorry. The two representations differ not so much in terms of the semiotic work or the principles involved than in terms of the social positioning of the learner that is the result of that semiotic work. This way of viewing 'realism' also allows us to be somewhat more precise by focussing on semiotic work: what is being made realistic in what ways and by what means.

LAYOUT

The change in sentence complexity might seem evidence both of a *loss of* complexity and of security of knowledge. That view however takes no account of concurrent social/pedagogic changes, leading to developments *in layout*. *Layout* is the new mode on the block. It allows textbook designers to articulate relations between elements and 'propositions', some previously made in *image* or in *writing* and to make or suggest types of relations which may not have been possible before. We will illustrate this with some examples from English textbooks on poetry.

Photo. W. J. Mansell

MILTON DICTATING 'PARADISE LOST' TO HIS DAUGHTERS
BY MUNKACSY

LESSON NINE

LITERATURE

'L'ALLEGRO.'

The Elizabethan age was succeeded by a period of religious and political strife, which culminated in the triumph of Puritanism under Oliver Cromwell. Therefore the expansive development of literature was restricted, and thought mainly concentrated on one particular book—the Bible. The dominating figure of this age is John Milton, the great Puritan poet; but he is so supremely an artist that he blends the perfection of ancient art, as learnt from the Renaissance, with the religious turmoil of his time, which has had so profound an effect on his work. His most famous poem is the epic *Paradise Lost*, which relates the story of 'man's first disobedience and its fruit.' He also wrote many shorter poems, of which the following is an example.

L'ALLEGRO

Haste thee, Nymph, and bring with thee
Jest, and youthful jollity,
Quips, and cranks, and wanton wiles,
Nods, and becks and wreathèd smiles,
Sport that wrinkled Care derides,
And Laughter holding both his sides.
Come, and trip it as you go,
On the light fantastic toe;
And in thy right hand lead with thee

Figure 8.

Figure 9a & 9b.

Figure 8 is set on a single page, using one or two columns per page. There is no background colour. In Figure 9 – a response to the Vietnam War – the two-page spread is tessellated with full-colour graphic elements overprinted on a decorative background of butterflies. The left-hand page contains five separate textual 'chunks'. Proximity and (small) overlaps suggest connection, differently and more or less strongly. The differential use of modes suggests a division of some kind: image for two 'chunks', writing for three, potentially signifying a functional distinction. This is reiterated through the tilting of the images –opposed to the straight positioning of the blocks of writing – one suggesting casualness, the other formality - an implied ontological difference of writing and image. The layout suggests 'assemblage', bringing together different materials and representations. This puts differences in *writing* between Figures 8 and 9 into perspective: the ordering of propositions is more articulated in *writing* in 8, and differently yet equally strongly in layout, in 9. The linear *layout* in Figure 8 is the semiotic work of an 'author'; the non-linear *layout* in Figure 9 is the semiotic work of the graphic designer.

The physical format of textbooks has changed, allowing for changes in layout. Textbooks from the 1930s are A5 sized or smaller. Their pages are, typically, designed following a rigid grid, in a single column, with consistent margins, baselines, headers and footers, allowing the writing to flow continuously from one column to the next from top left to bottom right; it runs across pages. In the 2000s, the book is bigger, and we see a move away from the rather rigid, writing-driven grid which was common in the 1980s. Most textbooks now use varying numbers of columns per page, varying column widths, allowing writing to be 'wrapped around' - often irregularly shaped - images. Writing may still be running across pages but more often page breaks coincide with separations of different parts of the text, marked off by line boxes and background colours. This allows the designer to produce forms of cohesion and composition which the author, when still 'in charge' of that, did not have, and which the learner did not encounter. For instance, the designer can suggest a modular organization of the text and create a multiplicity of reading paths rather than suggesting a linear reading path, fixing the order in which learners engage with various parts of the text.

TYPOGRAPHY

Textbook makers use the resources of typography to frame written representations pedagogically. Take the following two excerpts from English textbooks. The two differ typographically and in layout. In Figure 8, poem and 'materials' are clearly separate, as 'main item' and 'technical resource'. In Figure 10, poem and supplementary materials are integrated, using leader lines to connect the 'annotations' to parts of the poem. Figure 10 uses bolding to highlight 'difficult words', glossed in a separate text box. The poem is placed in a different colour to that framing the pedagogic materials. Figure 8 presents the poem as separate, with a literary and pedagogic 'apparatus' to be used as

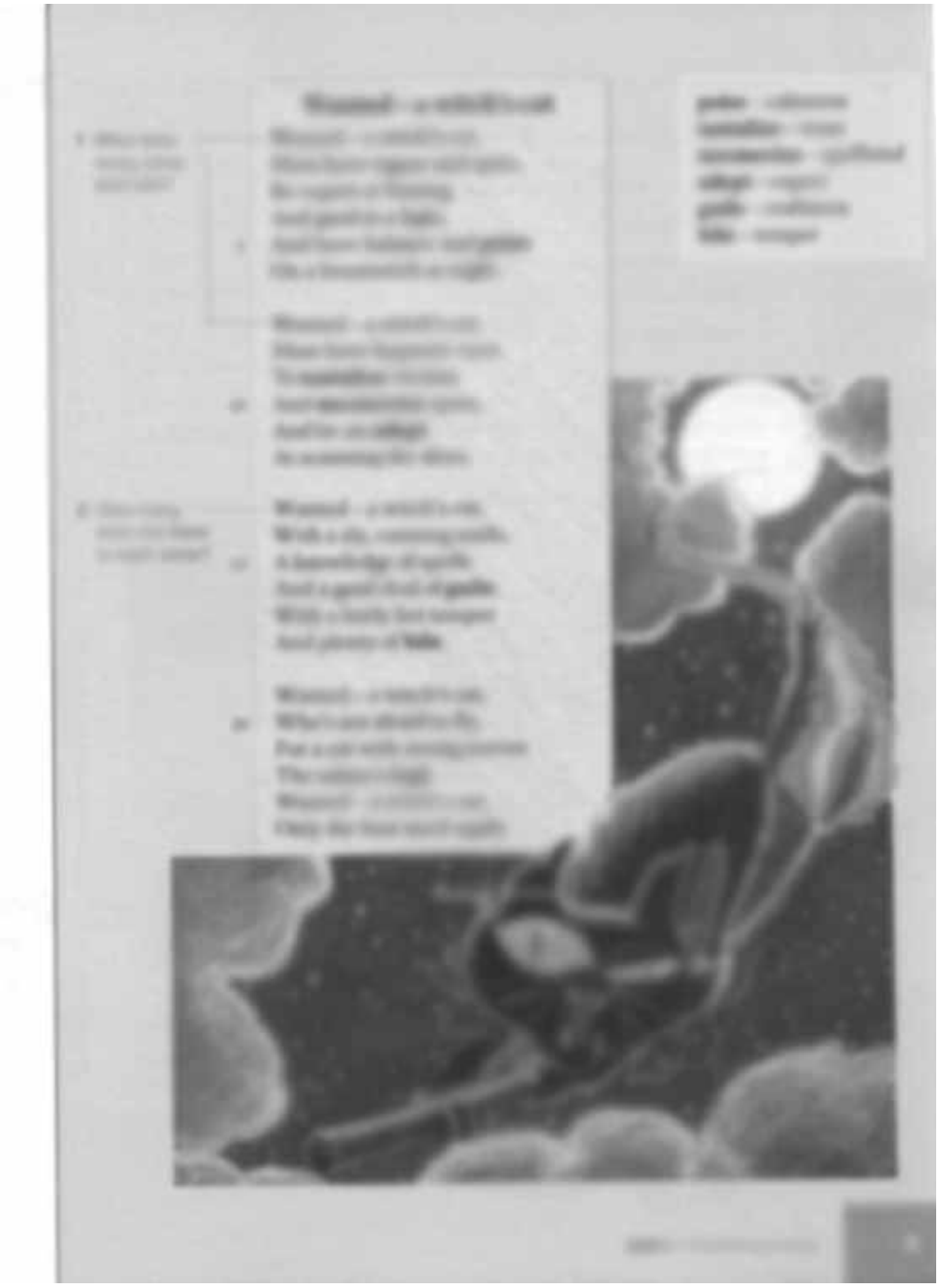

Figure 10.

Figure 10 presents the poem with several layers of meanings super-posed, doing semiotic work, which in 8 is left to the reader. In Figure 8 only line numbers are added to the poem; in Figure 10 the poem is fully drawn into a pedagogic framing: it has become a pedagogic rather than a literary object. We might hypothesize that the designers of Figure 10 envisage learners as unwilling or unable to engage with the poem in its 'pure' form; alternatively we might assume that the designers treat the 'poem' as a pedagogic object, as text-material for a specific pedagogic purpose, not immediately for its poetic characteristics. Engagement and pedagogic relations with a pedagogic object and an aesthetic one are very different.

Variation in type-face has increased significantly. Until the late 1980s usually one *font* was used consistently throughout a textbook; typically, in textbooks from the 2000s, different fonts are used for different parts of the text. In English textbooks investigated here, the poem, the introduction, instructions and annotations about what to do, are set in different fonts. From the late 1980s, type-face is used to separate out different curricular and pedagogic entities. Further, designers use the meaning potentials of type-face to suggest meanings of different entities: the literary 'feel' of serif is used for poems, handwritten font to represent annotations as 'notes', as provisional, unpolished. Instructions or exercises may be set in sans serif, suggesting they are transparent, straightforward and unambiguous. *Indentation* is in decline; *boxing and/or background colouring* are now common features. These mark boundaries between parts of the text sharply, suggesting that they operate as separate entities. The shift from indentation to boxing/colouring points to a modal change: written elements are increasingly acting like graphic entities, themselves connected not through cohesive devices of writing but through the *layout* of the page. The former linearity of writing is giving way to the modular organization of layout.

CONCLUSION

Typography, image, writing and *layout* contribute to meaning in text in ways significant for social relations within and across its makers and users. In textbooks, typography and image are used to construct and differentiate between different imagined abilities as much as writing does (cf. highlighting words which are assumed to be 'difficult' for certain potential readers; using 'abstract' representations of an electric circuit for 'advanced' readers). This has important implications for researching and evaluating textbooks and text more widely: Text designed for readers to engage with aspects of the world cannot be fully understood without due attention to all modes operating in that text.

The use of *typography, image, writing* and *layout* has changed between 1930 and now. Layout is now a major resource for constructing text, connecting parts of the text through their arrangement on a 'two-page spread' which were previously held together by cohesive devices in writing. This is socially significant as a) layout affords the designer the means to produce forms of cohesion and composition which the 'author' cannot achieve- and vice versa:

for instance a modular instead of a linear organization; b) these new forms of composition need to be understood by the reader.

For producers of textbooks the changes in design suggest a shift in their social/pedagogic relations, for instance where the designer now takes responsibility for coherence, which was previously the domain of the author. For users of textbooks the changes in design demand new kinds of textual understandings: a fluency not only in 'reading' writing, image, typography and layout jointly, but an understanding of the overall design of learning environments. The changes in the design of textbooks are also indicative of shifts in pedagogic relations between producers and users; for instance, where previously reading paths were fixed by producers it may now be left to learners to establish these according to their interests.

The radical shift in textbook design could be described – wrongly - in terms of 'dumbing down'; or, as we suggest, in terms of the *gains and losses* in wider social changes and features of the contemporary media landscape. *Lost* are certain forms of written complexity, stability, canonicity and vertical power structures. *Gained* are 'horizontal', more open, participatory relations in the production of knowledge, blurring former distinctions within and across production and consumption, writing and reading, and teaching and learning. We do not want to claim that the gains and losses we have identified are 'positive' or 'negative', nor do we dismiss such claims made by others. We believe that both gains and losses need to be attended to and understood by all those who wish to understand contemporary environments of learning, regardless of one's evaluative framework. We hope to have shown in this paper that a social semiotic take on text and text making contributes to that understanding.

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Figures

Figure 1: From Holmyard (1935)
Figure 2: From Webb & Grigg (1937)
Figure 3: From Hill & Holman (1986)
Figure 4: From Stone, Andrews & Williams (1988)
Figure 5: From Fraser & Gilchrist (1986)
Figure 6: Science Education Group (2002)
Figure 7: From Chapman & Sheehan (2003)
Figure 8: From Heath (1986)
Figure 9: From Brindle, Machin and P. Thomas (2002), Pp. 100-101.
Figure 10: From Baker, Constant and Kitchen (2003)

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Appendix

Excerpt 1: From Field (1937), p. 59

"If two cells are joined together negative pole to positive pole, the circuit wires being taken from the free + and - terminals, they are said to be joined in series. In this arrangement of cells the total E.M.F. is the sum of that of the cells that are joined together. Thus, with the two dry cells the total E.M.F. would be nearly 3 volts. If, however, the two cells were joined positives together and negatives together, the circuit leads being taken one from the joined positives and the other from the joined negatives, the total E.M.F. would still only be that of one cell, although the battery of two cells could give nearly twice as much current. In this arrangement the cells are said to be joined in parallel. In all the batteries we have studied and used the cells have been joined in series. A third method of joining the three cells would be to join two positives or two negatives together, and then take the circuit leads from the two remaining identical terminals. This method would produce no E.M.F. and no current, for the two cells would be in opposition. These three possibilities are shown in Fig. 41. In this figure we again use the diagrammatic method of showing cells; two parallel lines. The longer, thinner line represents the positive terminal, the shorter thicker one the negative terminal."

Excerpt 2: From Hill & Holman (1986), pp. 104-105.

All the circuits that we have looked at so far have been connected in series. In a series circuit, there is only one route for the current, because there are no junctions. Look closely at the circuit diagram in figure 10.1 which contains two bulbs and three ammeters in series. When the circuit is complete, all three ammeters show the same reading, 0.2 amperes. This is because the current is the same at all points in a series circuit. Electrons leaving the negative side of the battery pass through each section of the circuit at the same rate, so the current is the same at all points. Figure 10.2 shows a circuit in which the bulbs are not connected in series. In this case, each bulb is connected singly across the battery. There are junctions in the circuit and more than one way for the current to flow round it. This time the bulbs are said to be connected in parallel.

Excerpt 3: From Chapman & Sheehan (2003), p. 106.
"Series circuits
In series circuits the lamps are arranged side by side in the same loop as shown here. The more lamps there are, the more the current is slowed down through the whole circuit. The lamps shine less brightly than if there was only one lamp.

Parallel circuits
You can connect several lamps to the same size cell but keep them as bright as just one would be. You can put them in different loops. Look at the diagram on the right. This is called a parallel circuit. The diagram shows the current in a parallel circuit. The current branches off and goes through the two bulbs at the same time, not one after another. So, the current is not slowed down twice."