Financial Accountability & Management, 10(3), August 1994, 0267-4424

AN EMPIRICAL STUDY OF GRAPHICAL FORMAT CHOICES IN CHARITY ANNUAL REPORTS

VIVIEN BEATTIE AND MICHAEL JONES*

INTRODUCTION

During the last decade there have been major developments in the theory and practice of external financial reporting by charities. The surrounding debate has concerned two fundamental issues: first, the need for, and nature of, a regulatory framework for charities and, second, the appropriate content of charity annual reports. This debate has taken place, in part, within the context of a wider discussion concerning financial reporting in the public sector.

The continuing debate over a regulatory framework for charities has recently culminated in the publication of the Charities Act (1992) and a proposed new Statement of Recommended Practice No. 2, *Accounting by Charities* (SORP 2 Rev.) (Charity Commission, 1993). This focus on the development of a regulatory framework for charities reflects the increasing recognition of their public interest nature. With the annual turnover for the charitable sector now estimated at £15 billion (four per cent of gross national product) and the continuing 'privatisation' of former governmental organisations such as hospital trusts, charitable organisations are a significant and integral part of the economy (Banking World, 1991).

Discussion about the appropriate content of charity annual reports has led to recognition of the need for an adequate conceptual framework for financial reporting in not-for-profit sectors (Mayston, 1992). A significant contribution to such a framework has been provided by Hyndman (1990 and 1991) who develops an *a priori* model for reporting to charity contributors and provides empirical validation of this model through questionnaire research. This model does not, however, consider the manner in which information is disclosed, a limitation which Hyndman himself recognises (1990, p.305). The purpose of the present paper is to explore the use of graphs as an alternative format for the presentation of information to interested parties.

The Charity Commission recognises that charity annual reports now commonly use graphs to convey information (1993, p.3), since graphs have the potential to enhance the communication process. This is reflected in the Charity Annual Report and Accounting Awards, which are judged on 'readability, good design and clarity of presentation'. A recent winner, CARE Britain, was selected partly on the basis of its striking graphs (Collett, 1991).

* The authors are respectively, Senior Lecturer in Accountancy and Finance at the University of Stirling; and Lecturer in Accounting at Cardiff Business School. They would like to thank the 47 charities which sent their annual report, and they are also grateful to Dick Edwards, Maurice Pendlebury and Mike Waterland for their comments.

It is also possible, however, for graphs to inhibit or even distort the comprehension of information if the principles of graph construction are not complied with. Non-compliance may be caused either by ignorance of these basic principles or by a desire to present information in a certain way. For example, financial graphs may not accurately represent the underlying financial information, may portray it selectively or may give certain aspects of the information undue prominence.

Objectives

The general aim of this empirical study is to investigate, for the first time, presentational format choices involving graphs in charity annual reports. This will provide new insights into the public interest nature of the financial communication process of charities. There are three detailed objectives:

1. To investigate the issue of graphical presentation within the context of both the information needs of charity contributors and the reporting incentives of charity managers.
2. To identify the types of graph used and analyse their degree of compliance with established principles of graph construction, focusing on selectivity, measurement distortion and presentational enhancement.
3. To investigate whether there is any evidence that graphs are used to systematically portray the charity's performance in a favourable light.

To conduct an analysis of measurement distortion in segmental graphs we build upon earlier theoretical work by Tufte (1983). Tufte's index of distortion was developed to measure discrepancies in time series column graphs. We develop two new indices designed to measure discrepancies in segmented bar/column graphs and in pie graphs. We also explore, for the first time, inherent problems in using ellipses as a presentational format.

Structure

The paper contains six further sections. The next section briefly reviews the context of charity reporting, in particular the information needs of interested parties. The relevant graphics literature is summarised in the third section. The fourth section contains a discussion of managerial reporting incentives. The research methods employed in the study are outlined in the fifth section, and this is followed by a presentation of the results. The conclusion summarises our findings and suggests some policy implications.

THE CONTEXT OF CHARITY REPORTING

The user needs model, broadly adapted from that used in financial accounting in the private sector, is well-established both in the USA and the UK as a useful basis for a conceptual framework for not-for-profit reporting (see, for example, Jones and Pendlebury, 1984; and Henke, 1988). The ASC (1984) has identified six major groups of charity annual report users: trustees and management, members and donors, regulatory bodies, creditors, beneficiaries and voluntary workers, and employees.

There has, however, until recently been little progress in establishing the detailed information needs of these users, with Hyndman's (1990 and 1991) work representing an exception. Hyndman (1991) conducted a questionnaire study of 63 auditors and 148 charity officials from two hundred of the largest UK fund-raising charities. He established that contributors were perceived as by far the most important user group (cited by 69 per cent of charity officials and 73 per cent of auditors) and that their actual and perceived readership of the annual report was consistently over 80 per cent. Indeed, as a communication link, the charity annual report is arguably of greater importance to contributors than the corporate annual report is to shareholders, since the availability and variety of alternative information sources is far more restricted.

Hyndman (1990) developed and tested a tentative conceptual framework of charity reporting to contributors which contained ten distinct information types.[1] Not all of these information types are quantifiable, and not all involve financial information. In his empirical validation of this framework, these ten information types were generally ranked as more important than four additional types relating to the audited financial statements and charity officers. Hyndman concludes that contributors will be better served by *simplified*, rather than *audited*, financial statements.

Six of the ten most important information types relate to financial and/or numerical information which is well suited to graphical portrayal. Moreover, the new draft SORP 2 (Rev.) acknowledges that many charities now issue summarised accounts which are often partly in graphical or other pictorial form (Charity Commission, 1993, p.3). There is thus, as Hyndman notes, a pressing need for 'research into the effectiveness of various information presentational formats' (p.305).

GRAPHICS LITERATURE

It is widely recognised that human information processing is contingent upon presentation format (Libby and Lewis, 1977). Over the last twenty five years there has therefore been considerable debate concerning the relative merits of graphical versus tabular presentation. Broad support has now emerged for the view that in low complexity tasks, which do not involve substantial information processing, graphs are superior to tables (Blocher, Moffie and Zmud, 1986; DeSanctis and Jarvenpaa, 1989; and Carey and White, 1991). Given the nature of the financial communication process in charities, where stewardship-based information acquisition needs take precedence over information evaluation decision making skills, charity graphs are likely to involve such lower complexity cognitive skills.

At each stage of the communication process — attention-getting, knowledge acquisition and recall — the visual nature of graphs is likely to prove beneficial. First, graphs are more likely to be noticed, especially if colour is used (Thibadoux, Cooper and Greenberg, 1986). Second, a greater amount of key information is likely to be acquired from the graph, particularly if trends are involved (Korol, 1986). Finally, since we can readily store the visual pattern formed by the shape of the graph in our memory, we are more likely to remember the information (Paivio, 1974; Leivian, 1980; and Martin, 1989).

If graphs are to fulfil their potential to communicate effectively, it is important that the graph types employed suit the data structures to be portrayed. There are four major types of graph: line, horizontal bar/vertical column, pictorial and pie. Line, bar and column graphs are based on Cartesian coordinate axes with, normally, two arithmetic scales. Line and column graphs, but not bar graphs, are considered suitable for time series data. Bar graphs are commonly used to portray categories, in which case the graph is based on a single scale. An alternative form of this graph type is the *single segmented* bar graph, which involves one subdivided bar and is also commonly used to display proportions and percentages. Pictorial graphs use iconic symbols to portray numerical quantities. The pie graph is a circle subdivided into segments, and is a common alternative to the bar graph in cases where the portrayal of categories is required. Where pie graphs depart from circularity, they are known as ellipses. Both bar and pie graphs are recommended for the display of proportions and percentages.

Of particular relevance to this study, given the prevalence of pie graphs which we found in charity accounts, is the ongoing discussion of the comparative strengths and weaknesses of bar versus pie graphs. Early studies generally favoured the bar/column graph (MacDonald-Ross, 1977, pp.370–375). This was justified on the basis that people are capable of judging the length of bars/columns more accurately than the area or angle of pie segments. Studies have also indicated that acute angles are under-estimated while obtuse angles are over-estimated (Cleveland, 1985, p.245). More recent empirical studies by Cleveland and McGill (1984 and 1985) support this ranking of visual dimensions based on perceptual accuracy. However, in a series of articles Lewandowsky and Spence challenge the overall superiority of the bar/column graph. They argue that the real-life use of bar and pie graphs involves *comparison judgements* rather than the *magnitude estimation* of individual proportions (Lewandowsky and Spence, 1989; Spence, 1990; and Spence and Lewandowsky, 1991). In a series of experiments involving comparison tasks, they conclude that, in general, 'there is little to choose between the pie and the bar chart, with the former enjoying a slight advantage if the required judgement is a complicated one, but that both forms of chart are superior to the table' (1991, p.61). Where, however, complex comparisons of segmental information are required, they believe that the way in which we mentally process graphic displays leads to pie graphs being clearly preferable to bar graphs, particularly when the segments are colour coded.

Having selected a suitable graph type, the graph's construction and design must conform with accepted graphic principles if it is to be effective (Schmid and Schmid, 1979; Schmid, 1983; and Tufte, 1983). The fundamental principle underlying graph construction is that the physical measurement of the graphical elements (for example, bar length, angle of pie segment) should be proportionate to the numerical values being portrayed. Failure to comply with this principle results in *measurement distortion*, which can be measured by comparing the size of the graphic effect with that of the numerical effect, using a form of Tufte's lie factor (1983, p. 56). In the case of coordinate graphs, the existence of a non-zero or broken axis or a non-arithmetic scale results in measurement distortion. In the case of pie graphs, the underlying circle is often tilted to form a disc or replaced by an ellipse. As a consequence, the segment areas and arc lengths are no longer proportionate to either the segment angles or the underlying numerical values. It is generally believed that the angle is the primary visual dimension employed in viewing pie graphs (Cleveland and McGill, 1984), although both area and segment arc length are commonly believed to influence perception (Schmid and Schmid, 1979, pp. 147–8; and Cleveland and McGill, 1985, p. 830). Certainly experimental studies involving a comparison task have shown disc elements to be judged less accurately than circle segments (Spence, 1990). In addition to these *specific* causes of measurement distortion, distortion often arises simply because of inaccurate construction.

Measurement distortion can be expected, if significant, to lead to perceptual distortion. Presentational problems can also distort the information conveyed by the graph. Graphical comprehension hinges around the presence of certain basic structural components — in coordinate graphs these include, *inter alia*, axes, scales, labels and the graphical specifiers (for example, columns); in pie graphs these include labels and the segments which comprise the graphical specifiers. These structural components must normally both exist, and comply with accepted graphical conventions, if the graphs are to be clear and unambiguous. Furthermore, the interrelationships between the constituent parts should not invite incorrect inferences nor should extraneous design elements obscure interpretation.

A number of writers have suggested general guidelines for the construction of pie graphs. These guidelines relate to the optimal number, ordering and positioning of segments. A maximum of four, five or six categories is recommended by Schmid and Schmid (1979, p.147), Schmid (1983, p.65), and Thibadoux et al. (1986, p.23) respectively. It is normally argued that the segments be ordered according to size, and arranged in descending order in a clockwise direction (Schmid and Schmid, 1979, p.148; and Thibadoux et al., 1986, p.23). The largest segment is to be located at the top, starting at 12 o'clock (Schmid and Schmid, 1979, p.148; and Thibadoux et al., 1986, p.23). Thibadoux et al. (1986, p.23) argue that miscellaneous segments should be placed last, regardless of size. Finally, Kosslyn (1985) argues that individual segments should not be 'exploded' from the remainder of the pie as this may attract undue attention to them.

A further problem arises when pie graphs are shown in three dimensions, since only the front part of the rim is apparent. If the rim sections are the same colour as the associated segments, then another potential source of perceptual distortion is added. The additional area associated with these front segments must be ignored for accurate judgements to be made. It is also possible for pies to be shown in perspective projection. In this case the centre of the circle is located nearer the back (i.e. top) of the graph, distorting the relative size of segments.

Modern business graphics packages typically permit many different graph styles (for example, Harvard Graphics has a dozen different ways of presenting a pie graph). The problems which this can cause are well summed up in a recent software review 'you don't even have to fully understand the different types of chart: you just choose the one that looks best' (Mansfield, 1992, p.154).

There have been five systematic empirical studies on the use of graphs in the context of external financial reporting: two US studies (Johnson, Rice and Roemmich, 1980; and Steinbart, 1989), two UK studies concerned with plc's (Beattie and Jones, 1992a and 1992b) and building societies (Beattie and Jones, 1992c), and one Irish study (Green, Kirk and Rankin, 1992). Each of these studies considers only profit-orientated organisations.

The general findings of these studies are broadly in agreement. Graphs were found to be widely used, with the two most extensive studies finding that approximately 80 per cent of leading US and UK companies use graphs (Steinbart, 1989; and Beattie and Jones, 1992a). The most popular variables graphed were turnover, profit before taxation, earnings per share and dividends per share in the case of plc's, and total assets, profit before taxation, mortgage advances and general reserves in the case of building societies.

These studies found the inclusion of graphs to be contingent upon a favourable financial performance by the organisation. In addition, there was a frequent and systematic incidence of both incorrectly constructed graphs and material measurement distortion. Moreover, three studies (Steinbart, 1989; Beattie and Jones, 1992b and 1992c) found that measurement distortion systematically portrayed the organisations concerned in a more favourable light than was warranted by the underlying financial information. The only systematic study of presentational issues revealed frequent instances of presentational enhancement (Beattie and Jones, 1992a). These findings of selectivity, measurement distortion and presentational enhancement are consistent with the predictions of positive accounting theory which suggest that the financial accounting process is not free from bias (Watts and Zimmerman, 1986; and Smith, 1992).

MANAGERIAL REPORTING INCENTIVES

To our knowledge issues of reporting bias have not been directly addressed for charitable organisations. Revsine (1991) has recently described the financial reporting process as 'selective financial misrepresentation'. He argues that 'this selective financial misrepresentation hypothesis cuts across both *public* and private sectors' (p.17, emphasis added). Certainly managers of all organisations have goals, only some of which are consistent with the organisation's objectives. There is no evidence that managers of charities are less influenced by private goals than managers of other enterprises, and yet there may be fewer constraints upon those desires (Hadley, Webb and Farrell, 1975). Indeed, an important concern is that the lack of constraints upon charity managers may lead them to pursue their own goals at the expense of the donors or of the charity (Hyndman, 1991, p.81). In addition, most large charities are now managed by professional administrators, rather than 'concerned citizens' (see, for example, Gambling, Jones, Kunz and Pendlebury, 1990, p.50). Consequently, there is an increased emphasis upon effectiveness and efficiency with charities competing with the private sector for the best available staff (Randall, 1992). Moreover, the increased accountability brought about by the new charity regulations, and the outside pressures caused by cuts in government support and more intense competition for private-sector giving, can be expected to increase incentives to conceal unfavourable information.

For charity managers a particular area of financial concern may be the ratio between administration expenses and expenditure upon direct charitable activities. This has traditionally been regarded as a measure of the efficiency and effectiveness of charities (Randall, 1992). Managers may thus have incentives to minimise or de-emphasise their administrative expenses *vis-à-vis* their charitable expenditures. In terms of net surpluses/deficits there may be countervailing objectives. On the one hand, managers may wish to portray their managerial skills in a good light by highlighting the amount of money raised during the year and stressing the charitable surpluses. On the other hand, managers may seek to follow accounting measurement and disclosure policies which de-emphasise income, thus portraying a needy image which may encourage future donors to subscribe more willingly. Such reasoning may lie behind the dogged determination of many charities to write off capital expenditure in the year incurred, rather than to capitalise and depreciate it in line with SORP 2 (see Gambling et al., 1990; and Hines and Jones, 1992).

RESEARCH METHODS

The top 50 UK fund-raising charities were selected from Charity Trends (Charities Aid Foundation, 1991). Letters were sent to these charities requesting their latest annual report and account (in both full and summary form). After three unsuccessful written requests, non-respondents were telephoned. Overall, a total of 47 charities' annual report and accounts were collected (a 94 per cent response rate). The charities are listed in the Appendix.

A data check-list was designed, with reference to the prior literature, to collect data on salient aspects of graph design and construction (Schmid and Schmid, 1979; Tufte, 1983; Cleveland, 1985; Kosslyn, 1989; and Beattie and Jones, 1992a and 1992b). It was then piloted and revised to more fully reflect the nature of the graphs typically encountered. The following categories of data were extracted from the annual reports:

Charity details:

- full charity name,
- year end,
- details of each annual document with a financial orientation,
- graphic designers, and
- selected financial information.

General graphical information:

- use/non-use of graphs,
- location of graphs,
- prominence of graphs,
- topics graphed, and
- type of graph.

Specific graph construction details:

- degree of measurement distortion, calculated using a specially developed segmental discrepancy index,
- colour, and
- special effects.

Once the data had been collected it was checked for consistency, coded and analysed.

Index of Measurement Distortion

Measurement discrepancies for key financial graphs were calculated using a graph discrepancy index (see Tufte, 1983; Taylor and Anderson, 1986; and Beattie and Jones, 1992b). It was necessary to modify this discrepancy index, originally developed by Tufte for application to time series graphs, for use on the segmented graphs which we typically encountered. We are not aware of any previous research in any discipline into segmented graphs. We have termed our modified index a *segmental discrepancy index*. We define a discrepancy in the portrayal of an *individual* segment thus:

$$\text{segmental discrepancy index}_i\ (\text{sdi}_i) = \left(\frac{a_i}{b_i} - 1\right) \times 100\%, \text{ where}$$

a_i = physical ratio of segment to the whole (measured in cms or degrees, as appropriate),
b_i = numerical ratio of the segment to the whole (measured in £ or %, as appropriate).

Where the segment index is zero there is no distortion; positive (negative) values of the index indicate the degree of exaggeration (understatement) of the individual segment. Since the significance and interpretation of segments can vary, it is important to conduct the analysis at the individual segment level. An aggregate graph discrepancy index can then be defined as a weighted average of the absolute values of the individual segmental discrepancy indices:

$$\text{Aggregate Graph Discrepancy Index (AGDI)} = \sum_{i=1}^{n} b_i\,|\text{sdi}_i|,$$

where $0 \leq \text{AGDI} \leq \infty$.

Given the compensatory nature of segmental distortions, signs are ignored and the absolute values are taken in order to prevent the overall index summing to zero in every case. Thus the overall index does not distinguish between over- and under-statements, as is possible with time series graphs. As with Tufte's index, where the overall index is zero there is no distortion. The magnitude of the overall index is an indicator of the extent of segmental distortion within the total graph.

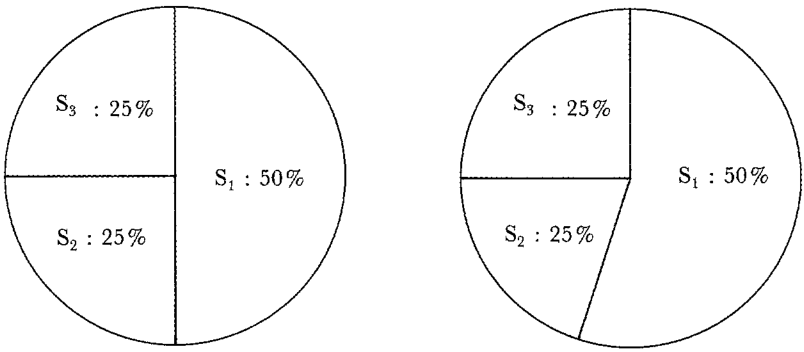
An illustration of measurement discrepancy is given in Figure 1. The pie graph in panel 1 is accurately constructed while that in panel 2 overstates the largest segment S_1 by 10 per cent. A distortion in one segment must, of course, be compensated for by a distortion in the opposite direction in other segments. In this example, segment S_2 is understated by 20 per cent, resulting in an overall graph discrepancy index of 10 per cent.

RESULTS

Our request for the 'latest annual report and accounts' and 'any summary leaflet concerning financial matters' elicited a total of 76 different documents from the 47 respondents. Table 1 classifies these documents according to generic title, giving the number (and corresponding percentage) of documents in each category which (i) contained graphs, (ii) contained audited information and (iii) contained both graphs and audited information. Graphs

Figure 1

Illustration of Measurement Distortion in Segmented Graphs



Panel 1: correct   Panel 2: incorrect

With reference to panel 2,

$$\begin{aligned}
\text{sdi}_1 &= \left(\frac{198°/360°}{0.5} - 1\right) \times 100\% \\
&= \left(\frac{0.55}{0.5} - 1\right) \times 100\% \\
&= +10\% \\
\text{sdi}_2 &= \left(\frac{72°/360°}{0.25} - 1\right) \times 100\% \\
&= \left(\frac{0.2}{0.25} - 1\right) \times 100\% \\
&= -20\% \\
\text{sdi}_3 &= 0\% \\
\text{Thus AGDI} &= \sum_{i=1}^{3} b_i \, |\text{sdi}_i| \\
&= (0.5 \times 10\%) + (0.25 \times 20\%) + (0.25 \times 0\%) \\
&= 10\%
\end{aligned}$$

per se are traditionally not audited, although they may appear in 'audited' documents. Interestingly, though, in three cases there was some ambiguity concerning this, since the pages referred to in the auditor's report did contain graphs.

Graphs were found in 58 per cent of all documents. The report and accounts, and financial statements, tended to contain relatively more

Table 1

Use of Graphs in the 76 Annual Reporting Documents of 47 Large UK Charities

	Documents Containing Graphs		*Documents Containing Audited Information*		*Documents Containing Graphs and Audited Information*		
Generic Title of Document Category	*No.*	*Per Cent of Document Category*	*No.*	*Per Cent of Document Category*	*No.*	*Per Cent of Document Category*	*Total No. of Documents in Each Category*
Report and accounts	10	38	20	77	8	31	26
Financial statements/ annual accounts	3	21	14	100	3	21	14
Annual review	13	93	2	14	2	14	14
Annual report	14	78	7	39	4	22	18
Other e.g. broadsheets	4	100	1	25	1	25	4
Total	44	58	44	58	18	24	76

quantitative, financial information than the other types of document, were generally audited documents, and were less likely to contain graphs. By contrast the annual review, annual report, and other documents tended to be discursive in nature, to contain graphs and be unaudited. The majority of charities produced multiple documents (25 sent two documents, two sent three). Despite the recommendation that the term 'annual report' be used only for a brief explanatory formal report accompanying the accounts, while 'annual review' should refer to a larger, more informative document (Bird and Morgan-Jones, 1981), this was clearly not the general practice.

Given the variety of documents containing graphed financial information, we decided not to restrict our analysis to audited documents. The 44 documents which contained graphs covered 35 (74 per cent) charities and included a total of 119 graphs. This represents an average of 2.5 graphs per charity (n = 47), with the figure rising to 3.4 based on only those charities using graphs (n = 35). An analysis of the topics graphed is given in Table 2. The two most frequently graphed topics were analyses of total annual income and expenditure, commonly termed 'where the money comes from' and 'where the money goes'. The next most frequently graphed topic related to expenditure on direct charitable activities, expressed in financial terms. For example, the Royal Society for the Protection of Birds, whose principal activity is ornithological conservation, analysed their total conservation

Table 2

Analysis of Topics Graphed

Topic	*Total No. of Graphs*	*Per Cent*	*No. of Charities Graphing Topic (n = 47)*	*Per Cent of Charities*
Key Financial Graphs				
Total income	26	22	20	43
Total expenditure	30	25	24	51
Direct charitable activities	18	15	17	36
	74	62		
Other Financial Graphs	22	19	12	26
Total financial graphs	96	81		
Non-financial Graphs	23	19	8	17
Total	119	100		
Average number of graphs per charity ($n = 47$)	2.5			
Average number of graphs per charity using graphs ($n = 35$)	3.4			

expenditure into four categories: (i) national and international work to research into and protect species and habitats, (ii) managing nature reserves, (iii) buying land to develop into nature reserves and adding to existing nature reserves, and (iv) raising public awareness of conservation including publications, films and education.

These three graph topics, all of which are financial, jointly accounted for 62 per cent of all graphs. We term graphs of these topics 'key financial graphs' (KFGs). Table 2 shows that 43 per cent of top charities graph total income, 51 per cent graph total expenditure and 36 per cent graph direct charitable activities. The high frequency of expenditure graphs is consistent with the principal need of users, which is to see how funds have been used (Charity Commission, 1993). These findings do not, however, tie in well with Hyndman's (1990 and 1991) findings. We find that the graphs most frequently presented by charity managements are of financial operating data, whereas Hyndman found that the simplified operating statement and audited operating statement were ranked comparatively lowly by charity officials, auditors and contributors. Only the audited operating statement was ranked in the top five out of 14 information types — and this by the auditors. The reason for this apparent discrepancy is puzzling. Perhaps 'output' or 'efficiency' measures, two of Hyndman's information types, capture some of the graphed data. Alternatively, the information types which Hyndman presented to his respondents may not have been sufficiently disaggregated. In other words, had the operating statement been broken down into separate elements (for example total income or total expenditure), his respondents may have replied differently.

The remaining graphs were split almost equally between other financial and non-financial topics. The comparatively low number of non-financial graphs is perhaps disappointing to those such as Gambling and Jones (1991) who emphasise that non-financial statistics can be very informative in charity accounts.

We found no relationship between a charity's use of graphs and either whether it made a surplus/deficit or its level of administrative expenses. This was tested using the chi-squared test based on the classification of administrative expenses as above/below the mean and median percentage. These findings held both for the use of graphs in general and for the use of KFGs in particular.

Key Financial Graphs

The distribution of the 74 KFGs by generic type is given in Table 3. The vast majority of these graphs covered one year only, with only nine graphs (12 per cent) showing time series. The most common graph type employed was the pie. The generic pie graph, which is particularly useful for portraying segmented information, was used for 58 per cent of total income graphs and 67 per cent of total expenditure graphs. The commonest specific type of pie graph was the disc/ellipse with a rim. Although visually appealing, this graph type suffers from potential perceptual problems arising from its departure from circularity. These issues are considered below in more detail.

Table 4 shows the number of categories displayed by each of the KFGs. Eight of the 13 graphs with seven or more segments were pie graphs. Thus, 20 per cent of pie graphs exceed the maximum number of segments recommended by Thibadoux et al. (1986).

Many of the 40 pie graphs also breached other rules of good graphical design (outlined above). Only 50 per cent of the pie graph segments were ranked in descending size order, as recommended by Schmid and Schmid (1979) and Thibadoux et al. (1986). Of these 20 graphs, in six the segments were ranked anticlockwise, again contrary to recommendations and only one began at 12 o'clock. Furthermore, 14 were drawn so that one or more segments 'exploded' from the centre — a practice criticised by Kosslyn (1985). This technique was particularly prevalent amongst the expenditure graphs.

A particular difficulty encountered by the researchers was the reconciliation of the numerical values of the KFGs to the underlying audited financial statements. Of the 70 cases where the numerical data enabled an attempt at reconciliation to be made, the reconciliation was unclear in 19 instances. In another six cases only the totals were reconcilable, a different (not merely simpler) categorisation being used for segments in the graphs than for the financial statements.

Table 3

Distribution of Graphs by Generic Type

Generic Type of Graph		Total Income No.	Total Income Per Cent	Total Expenditure No.	Total Expenditure Per Cent	Direct Charitable Activities No.	Direct Charitable Activities Per Cent	Total No.	Total Per Cent
Pie:	— circle	1	4	2	7	2	11	5	7
	— circle with rim	—	—	—	—	1	6	1	1
	— disc/ellipse with rim	12	46	17	57	2	11	31	42
	— other	2	8	1	3	—	—	3	4
Total		15	58	20	67	5	28	40	54
Bar/column:	— single segmented bar/column/cylinder	5	19	5	17	2	11	12	16
	— multiple bar/column/cylinder	5	19	4	13	4	22	13	18
	— time series variant	1	4	1	3	6	33	8	11
Line	— time series variant	—	—	—	—	1	6	1	1
		26	100	30	100	18	100	74	100

Table 4

Number of Categories Displayed in Key Financial Graphs

No. of Categories	*Total Income*	*Total Expenditure*	*Direct Charitable Activities*	*Total*
1	—	—	5	5
2	—	—	1	1
3	3	6	1	10
4	10	10	3	23
5	3	5	2	10
6	5	4	3	12
7	1	2	1	4
8	3	2	—	5
≥9	1	1	2	4
Total no. of graphs	26	30	18	74
Mean no. of categories	5.2	4.9	5.1	5.0

In order to ascertain how faithfully the graphs represent the underlying financial data the individual segmental discrepancy index was applied, where relevant, to the largest two segments for 52 of the total income and total expenditure graphs. Discrepancies in excess of five per cent were defined as material, based on the arguments of Pany and Wheeler (1989) and Tufte (1983). The results, shown in Table 5, reveal that 50 per cent of segments contained a material distortion of over five percent (21 per cent positive; 29 per cent negative). There was a mean discrepancy score of −0.05 per cent for the largest graphic segment and 1.36 per cent for the second largest. Thus, while almost half of these individual segments show material distortion, there is no evidence of systematic bias. Four graphs were excluded from this analysis since the nature of their design immediately introduced severe distortion.

In addition to the individual segmental discrepancy index, we calculated an estimated aggregate graph discrepancy index (AGDI). All segments in excess of ten per cent of the total were included: smaller graphic segments were excluded due to the difficulty of accurate measurement. The mean AGDI was 8.4 per cent. Sixty per cent of the key total income and total expenditure graphs showed material aggregate discrepancies.

It is important to emphasise that in many cases the distortions calculated in Table 5 are based on segment *angles*. Since 31 of the 40 generic pie KFGs (i.e. 78 per cent) are ellipses, rather than circles, the segment *areas* (and arc lengths) will, as a consequence, be distorted even if the angle is not. In essence, an ellipse is an elongated circle, with two foci and a major and minor axis. A typical ellipse is demonstrated in Figure 2, panel (a). The distance from the F1 focus to the F2 focus via any point on the circumference is equal to the length

Table 5

Measurement Distortion in Key Total Income and Total Expenditure Graphs

Size of Discrepancy (x%)	*Largest Segment (sdi_1)*	*Second Largest Segment (sdi_2)*	*Estimated (AGDI)*
$-50 \leq x < -25$	1	8	n/a[2]
$-25 \leq x < -10$	5	6	n/a[2]
$-10 \leq x < -5$	4	6	n/a[2]
$-5 \leq x < 5$	31	21	21
$5 \leq x < 10$	6	—	12
$10 \leq x < 25$	4	3	18
$25 \leq x < 50$	1	3	1
$50 \leq x$	—	5	—
Not applicable[1]	4	4	4
Total	56	56	56
Mean score (%)	−0.05	+1.36	+8.4

Notes:

[1] The design of four graphs immediately introduced severe distortion. In two cases the graphs consisted of columns of coins. It became apparent, however, that it was the value of the coins shown in each column, rather than the height of column, which was the relevant specifier. Misinterpretation of these graphs would result in an average segment distortion of +267%. In the other two graphs, which were pie graphs, the origin of the pie was not located centrally. This fundamentally undermines the conceptual integrity of this graph type.

[2] Negative values are not possible since the index is based on the *absolute* values of the segment discrepancy indices.

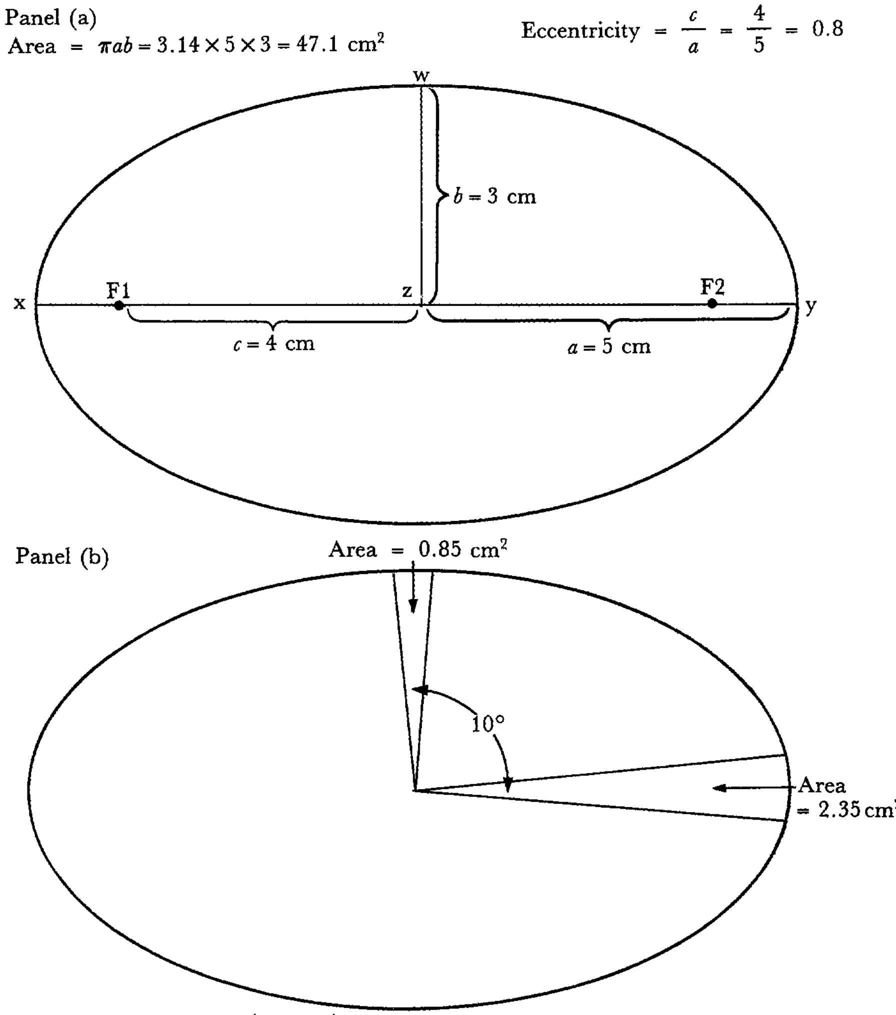
of the major axis (xy). The area is 47.1 cm^2 and the eccentricity, or 'skinniness' of the ellipse is 0.8.[2]

The nature of segment area distortion is illustrated in Figure 2 panel (b). Two segments are shown, each of 10°. One of these is centred on a semimajor axis (zy) and one on a semiminor axis (zw). These are the most extreme positions possible. The segment areas, estimated using a mm^2 grid, are 2.35 cm^2 and 0.85 cm^2 respectively. This yields segment area discrepancy indices of 80 and −35 per cent respectively. Given that area is a major visual dimension utilised in the perception of pie graphs, although subordinate to angle (Cleveland and McGill, 1985, p.830), distortions are immediately introduced into the majority of all charity income and expenditure graphs.

Accurate perceptions of area can also be impeded by the presence of a rim to the ellipse. This tends to emphasise those segments adjacent to the rim. Misperception is most likely where the rim reinforces the adjacent segment's colour — either by being the same colour or a different shade of the same colour. We found that of the 40 generic pie graphs, 31 ellipses and one circle (i.e. 80 per cent) are shown with a rim. In 12 cases, the colour of this rim

Figure 2

Illustration of an Ellipse and Segment Area Distortion



$$\text{Since sdi}_i = \left(\frac{a_i}{b_i} - 1\right) \times 100\%$$

$$\text{thus, sdi}_1 = \left(\frac{2.35/47.1}{10^\circ/360^\circ} - 1\right) \times 100\%$$

$$= +80\%,$$

$$\text{and sdi}_2 = \left(\frac{0.85/47.1}{10^\circ/360^\circ} - 1\right) \times 100\%$$

$$= -35\%.$$

corresponded exactly to that of the adjacent segments, in 14 cases it was the same colour albeit a different shade, and in six it was a different colour to any of the segments and therefore not associated (through the use of colour) to particular segments.

It was argued above that charity managers have incentives to focus attention away from administration expenses. In the case of ellipses, this can be achieved by locating this segment close to the minor axis. In order to test this hypothesis, we divided each expenditure ellipse into four quadrants, each centred on a semi-axis, and classified the administration expenses segment as falling into the quadrants centred on either the minor axis (which results in segment area understatement) or the major axis (which results in segment area overstatement). Of the 17 total expenditure ellipses, 16 contained an administration expenses category, with 6.5 of these centred on the minor axis, and 9.5 centred on the major axis. Total expenditure pie graphs which are drawn as ellipses are not, therefore, drawn in such a way that the segment area of the administration expenses is understated. Our sample size was, however, small.[3]

Charity managers also have incentives to focus upon direct charitable expenditure in total expenditure graphs. This segment was characteristically the largest segment displayed. Although we detected no systematic positioning of this segment to gain maximum presentational advantage, it may be noted that in 13 out of 17 total expenditure graphs with rims, the rim colour served to reinforce the impact of the direct charitable expenditure. Of the 10 non-pie total expenditure graphs, the positioning of the direct charitable expenditure segment was in seven cases either at the top of segmented columns/cylinders or at the right hand side of multiple bars/columns. It may be argued that this positioning utilises attributes of human information processing which cause this segment to be emphasised. First, western civilisation reads from left to right, and as a consequence the human eye will focus naturally upon the right hand side of any display. Second, the human eye is naturally practised at detecting deviations from the horizon and therefore will be drawn to the top, rather than the bottom, of an object (Tufte, 1983, outlines some of these principles).

CONCLUSION

This study investigates the nature and extent of graph usage in the 76 documents provided by 47 of the top 50 UK charities. Its main findings are that 74 per cent of charities use graphs with the most frequently graphed variables being single period analyses of total income, total expenditure and direct charitable expenditure. This focus is consistent with the Charity Commission's view that in assessing a charity's financial position the principal need is to see 'how incoming resources have been applied' (1993). It is, however, at variance with Hyndman's (1990 and 1991) ten information types — since none of these is commonly graphed. No evidence is found that charity graph usage is contingent upon either the charity making a surplus/deficit or upon the level of administration expenses.

Of the three key financial variables, 54 per cent were generic pie graphs, which is a type of graph well suited to the display of percentages and proportions. However, a large number of these pie graphs did not conform to recommended principles of pie graph construction in terms of the number of categories employed, and category ordering and positioning. In a significant minority of cases it was not possible to reconcile the figures used in the graphs with those in the audited accounts.

Modified discrepancy indices, developed to calculate measurement distortion in segmented graphs, revealed a significant number of materially distorted individual segments and evidence of aggregate graph distortion. We found, however, no evidence of systematic bias. In the case of the pie graphs, this index is based on the angle of each segment, which is believed to be a primary visual dimension involved in the perception of pie graphs. However, 78 per cent of the 40 pie graphs were in the specific form of ellipses, which means that the area of segments is no longer proportional to the segment angle. Weak evidence was found that the portrayal of the direct charitable expenditure segment in total expenditure graphs is designed to emphasise its perceptual impact.

We believe that future research is necessary in two major areas. First, it is important to explain the disparity between Hyndman's (1990 and 1991) findings concerning the information needs of contributors and the financial information actually graphed by charities. Second, further investigation is required into measurement distortion based on segment *areas* versus *angles* and the use of presentational enhancement in pie graphs.

These findings have an important policy implication. They demonstrate that graphs are an important means by which top charities communicate their financial activities and position. Given this, we believe that the Charity Commission should *explicitly* review the graphical presentation of summarised financial information and consider the development of guidelines for the use of financial graphs in charity financial reporting. These guidelines would assist trustees and external auditors in their proposed future review of such material and complement the new draft statement of recommended practice which deals with measurement and disclosure issues.

APPENDIX

List of Charities in Sample

Actionaid
Arthritis & Rheumatism Council
Barnardos
British Heart Foundation
British Red Cross Society
British & Foreign Bible Society
Cancer Relief Macmillan Fund
Catholic Fund for Overseas Development

Children's Society
Christian Aid
Church Urban Fund
Guide Dogs for the Blind Association
Help the Aged
Imperial Cancer Research Fund
Institute of Cancer Research
Jewish Care
King Edward VII's Hospital for Officers
Leonard Cheshire Foundation
Leprosy Mission (International)
Leukaemia Research Fund
Marie Curie Memorial Foundation
Multiple Sclerosis Society
National Children's Home
National Society for the Prevention of Cruelty to Children
National Trust
National Trust for Scotland
Order of St John
Oxfam
People's Dispensary for Sick Animals
Prince's Youth Business Trust
Royal Air Force Benevolent Fund
Royal British Legion
Royal National Institute of the Blind
Royal National Life Boat Institute
Royal Opera House Covent Garden
Royal Society for Protection of Birds
Royal Society for the Prevention of Cruelty to Animals
Salvation Army
Save the Children Fund
Sightsavers
Spastics Society
The Soldiers' Sailors' and Airmen's Families Association
St Dunstan's
Sue Ryder Foundation
Tear Fund
World Vision of Britain
World Wide Fund for Nature

NOTES

1 These ten information types are: (1) statement of goals, (2) statement of objectives, (3) problem/need area information, (4) measure(s) of output, (5) measure(s) of efficiency, (6) administration cost percentage information, (7) simplified operating statement, (8) simplified balance sheet, (9) statement of future objectives, and (10) budget information.

2 Mathematically, an ellipse is defined as the set of points for which 'the sum of the distances from two given points, called foci, is a constant quantity, which is larger than the distance between the foci' (Shipachev, 1988, p.64). This constant quantity is equal to the length of the ellipse's major axis. If the length of the semimajor and semiminor axes are denoted by a and b respectively, then the area of an ellipse is πab (Murphy, 1974, p.200). The 'skinniness' of an ellipse is termed 'eccentricity', denoted by e, which is defined as c/a, where c is the distance of the foci (denoted by F1 and F2) from the centre of the ellipse (Shipachev, 1988, p.67). Thus $0 \leq e < 1$, and in the special case of an ellipse that is a circle, there is a single focal point at the centre of the circle, and hence $e = 0$. It should be noted that the accurate construction of ellipses poses a number of drafting and typesetting difficulties. Minor errors are, therefore, to be expected (see, for example, in this respect our Figure 2!).

3 There was some evidence that, in those cases where administration expenses were emphasised (by being either 'exploded' from the pie, or placed adjacent to the semiminor axis at the 'front' of rimmed pies) the level of administrative expenses was below the sample mean. Perhaps, therefore, the presentation of this expense category is contingent upon its level, with charity managers wishing in some cases to emphasise their success in holding down such costs.

REFERENCES

ASC (1984), *Accounting by Charities: A Discussion Paper* (Accounting Standards Committee, London, 1984).

Banking World (1991) 'A Professional Approach to Investment' (December, 1991), p.30.

Beattie, V.A. and M.J. Jones (1992a), *Certified Research Report 31: The Communication of Information Using Graphs in Corporate Annual Reports*, Certified Accountants Educational Trust (London, 1992).

______ ______ (1992b), 'The Use and Abuse of Graphs in Annual Reports: A Theoretical Framework and Empirical Study', *Accounting and Business Research* (Autumn 1992), pp. 291–303.

______ ______ (1992c), 'The Creative Art of Societies' Financial Graphs', *CBSI Journal* (November 1992), pp. 13–15.

Bird, P. and P. Morgan-Jones (1981), *Financial Reporting by Charities* (ICAEW: London, 1981).

Blocher, E., R.P. Moffie and R.W. Zmud (1986), 'Report Format and Task Complexity: Interaction in Risk Judgments', *Accounting, Organizations and Society*, Vol. 11, No. 6 (1986), pp. 457–470.

Carey, J.M. and E.H. White (1991), 'The Effects of Graphical Versus Numerical Response on the Accuracy of Graph-Based Forecasts', *Journal of Management* (March 1991), pp. 77–96.

Charities Act (1992), HMSO.

Charities Aid Foundation (1991), *Charity Trends 14th Edition* (Charities Aid Foundation, 1991).

Charity Commission (1993), *Accounting by Charities*, SORP 2 Statement of Recommended Practice No. 2, Exposure Draft (March 1993).

Cleveland, W.S. (1985), *Elements of Graphing Data* (Wadsworth, 1985).

______ and R. McGill (1984), 'Graphical Perception: Theory, Experimentation and Application to the Development of Graphical Methods', *Journal of the American Statistical Association* (September 1984), pp. 531–554.

______ ______ (1985), 'Graphical Perception and Graphical Methods for Analyzing Scientific Data', *Science*, Vol. 229 (1985), pp. 828–833.

Collett, C. (1991), 'Achievers' Annual Balancing Act', *Accountancy* (November 1991), p.73.

DeSanctis, G. and S.L. Jarvenpaa (1989), 'Graphical Investigation of Accounting Data for Financial Forecasting: An Experimental Investigation', *Accounting, Organizations and Society*, Vol. 14, Nos. 5/6 (1989), pp. 509–525.

Gambling, T. and R. Jones (1991), *Accounting for Charities: A Position Paper* (University of Birmingham Research Paper, 1991).

______ ______ C. Kunz and M. Pendlebury (1990), *Certified Research Report 21: Accounting by Charities: The Application of SORP2*, Certified Accountants Educational Trust (London, 1990).

Green, P., R. Kirk and C. Rankin (1992), 'Graphs: the Use and Abuse', *Certified Accountant* (November 1992), p.34.

Hadley, R., A. Webb and C. Farrell (1975), *Across the Generations: Old People and Young Volunteers* (Allen and Unwin, 1975).

Henke, E.O. (1988), *Introduction to Non-Profit Organisation Accounting* (PWS-Kent: Massachusetts, 1988).

Hines, A. and M.J. Jones (1992), 'The Impact of SORP2 on the UK Charitable Sector: An Empirical Study', *Financial Accountability & Management*, Vol. 8, No. 1 (Spring 1992), pp. 49–68.

Hyndman, N. (1990), 'Charity Accounting — An Empirical Study of the Information Needs of Contributors to the Fund Raising Charities', *Financial Accounting & Management*, Vol. 6, No. 4 (Winter, 1990), pp. 295–307.

______ (1991), 'Contributors to Charities — A Comparison of Their Information Needs and the Perception of Such by the Providers of Information', *Financial Accountability & Management*, Vol. 7, No. 2 (Summer 1991), pp. 69–82.

Johnson, J.R., R.R. Rice and R.A. Roemmich (1980), 'Pictures that Lie: The Abuse of Graphs in Annual Reports', *Management Accounting* (October 1980), pp. 50–56.
Jones, R. and M. Pendlebury (1984), *Public Sector Accounting* (Pitman: London, 1984).
Korol, J.K. (1986), 'Graphical Perception and the Representation of Financial Information, *Georgia Journal of Accounting* (Spring 1986), pp. 147–157.
Kosslyn, S.M. (1985), 'Graphics and Human Information Processing: A Review of Five Books', *Journal of the American Statistical Association* (September 1985), pp. 499–512.
——— (1989), 'Understanding Charts and Graphs', *Applied Cognitive Psychology* (1989), pp. 185–226.
Leivian, G.M. (1980), 'How to Communicate Financial Data More Efficiently', *Management Accounting (USA)* (July 1980), pp. 31–34.
Lewandowsky, S. and I. Spence (1989), 'The Perception of Statistical Graphs', *Sociological Methods and Research* (November/February, 1989), pp. 200–242.
Libby, R. and B.L. Lewis (1977), 'Human Information Processing Research in Accounting: The State of the Art', *Accounting, Organizations and Society*, Vol. 2, No. 3 (1977), pp. 245–268.
MacDonald-Ross, M. (1977), 'How Numbers are Shown: A Review of Research on the Presentation of Quantitative Data in Texts', *Audio-Visual Communication Review* (Winter 1977), pp. 359–409.
Mansfield, S. (1992), 'Putting on a Show', *Personal Computer Magazine* (April 1992), pp. 132–159.
Martin, D.M. (1989), *How to Prepare the Annual Report* (Fitzwilliam Publishing, 1989).
Mayston, D. (1992), 'Financial Reporting in the Public Sector and the Demand for Information', *Financial Accountability & Management*, Vol. 8, No. 4 (Winter 1992), pp. 317–324.
Murphy, P. (1974), *Additional Mathematics Made Simple* (W.H. Allen, 1974).
Paivio, A. (1974), 'Spacing of Repetitions in the Incidental and Intentional Free Recall of Pictures and Words', *Journal of Verbal Learning and Verbal Behaviour*, Vol. 13 (1974), pp. 497–511.
Pany, K. and S. Wheeler (1989), 'Materiality: An Inter-Industry Comparison of the Magnitude and Stabilities of Various Quantitative Measures', *Accounting Horizons* (December 1989), pp. 71–78.
Randall, A.J.L. (1992), 'Charity Costs: Now It's Confession Time', *NGO Finance*, No. 8 (1992), pp. 16–17.
Revsine, L. (1991), 'The Selective Financial Misrepresentation Hypothesis', *Accounting Horizons* (December 1991), pp. 16–27.
Schmid, C.F. (1983), *Statistical Graphics: Design Principles and Practices* (John Wiley/Interscience, 1983).
——— and S.E. Schmid (1979), *Handbook of Graphic Presentation*, Second edition (Ronald Press, 1979).
Shipachev, V.S. (1988), *Higher Mathematics* (Mir Publishers, 1988).
Smith, T. (1992), *Accounting for Growth* (Century Business, 1992).
Spence, I. (1990), 'Visual Psychophysics of Simple Graphical Elements', *Journal of Experimental Psychology: Human Perception and Performance*, Vol. 16, No. 4 (1990), pp. 683–692.
——— and S. Lewandowsky (1991), 'Displaying Proportions and Percentages', *Applied Cognitive Psychology*, Vol. 5 (1991), pp. 61–77.
Steinbart, P.J. (1989), 'The Auditor's Responsibility for the Accuracy of Graphs in Annual Reports: Some Evidence of the Need for Additional Guidelines', *Accounting Horizons* (September 1989), pp. 60–70.
Taylor, B.G. and L.K. Anderson (1986), 'Misleading Graphs: Guidelines for the Accountant', *Journal of Accountancy* (October 1986), pp. 126–135.
Thibadoux, G., W.D. Cooper and I.S. Greenberg (1986), 'Flowcharts and Graphics', *CPA Journal* (March 1986), pp. 12–23.
Tufte, E.R. (1983), *The Visual Display of Quantitative Information* (Graphic Press, 1983).
Watts, R.L. and J.L. Zimmerman (1986), *Positive Accounting Theory* (Prentice Hall International, 1986).