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## Original articles

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### 3D or 3-D: a study of terminology, usage and style

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**Abstract** The terms “3D” and “3-D” are two alternative acronyms for the term “three-dimensional”. In the published literature both variants are commonly used but what is the derivation of the two forms and what are the drivers of usage? This paper surveys the published stereoscopic literature and examines publication-style policies to understand forces and trends.

**Keywords** Stereoscopic, 3D, 3-D, three-dimensional, style, terminology.

#### Background

The term “three-dimensional” has probably been with us since philosophers discovered and discussed the concept of dimensions. The term can be used to refer to anything that has height, width and depth – three dimensions. Conveniently, “three-dimensional” can also be abbreviated to “3-D” or “3D.”

The earliest example of the use of the term “three-dimensional” in relation to photography I have been able to locate is Kennedy (1936),<sup>1</sup> who wrote: “It is true that the most fantastic proposals purporting to disclose a short-cut to three-dimensional photography are repeatedly made by persons who claim that by chance or ingenuity they can produce a stereoscopic effect - note the word effect - without taking two pictures and particularly without providing adequate means whereby each eye sees its proper image.” However, he doesn’t use the abbreviation “3D” or “3-D” in the article.

The earliest example of the abbreviation “3-D” I have located is Spottiswoode et al. (1952),<sup>2</sup> who wrote: “Up to now the production of three-dimensional (3-D) films has been sporadic.” Perhaps there are earlier examples.

Although the acronym “3D” was first used in relation to stereoscopic 3D movies, and can also be used to refer to other stereoscopic topics including 3DTV, 3D displays, 3D cameras and 3D vision, it can also be used to refer to non-stereoscopic technologies including 3D printing (additive manufacturing), 3D computer graphics (using monoscopic depth cues to give a computer-generated image added realism), 3D laser scanning, 3D computer-aided design (CAD), 3D modelling, and DirectX 3D. In order to distinguish stereoscopic 3D from other uses of “3D” some authors use the term “s3D”, short for stereoscopic 3D.

It is apparent from the literature that in early times the hyphenated form of “3-D” was used predominantly. For at least the past 30 years, both the hyphenated and non-hyphenated forms “3-D” and “3D” have been in common usage. It seems formal English tends to prefer the hyphenated form, whereas modern usage tends to use the non-hyphenated form, but is there a right and a wrong? Can the two styles co-exist?

#### Methods

We start this examination by looking at the house styles of various publications relevant to the stereoscopic imaging field. We then consider current trends of usage of language in print. Finally we consider the implications of choosing one style or the other.

#### Results

First we present the results of the house style survey, and subsequently present the statistical occurrence of the two styles over the past 30 years.

#### House styles

Many publications have a house style that prescribes the use of the hyphenated version “3-D.” A number of publications were surveyed to determine their policy.

IEEE’s senior copy editor for IEEE Spectrum magazine, Joe Levine,<sup>3</sup> wrote:

IEEE publications like standards, transactions, and proceedings use a more formal style than IEEE Spectrum. While Spectrum doesn’t take up all the latest trends, we do consider the styles of mainstream magazines and newspapers. We’re encouraged to use a conversational tone. The traditional practice in most house styles is to spell out “three-dimensional” on first reference and then to use “3-D.” We only recently started allowing “3-D” to be used in all cases. Our editors urged me to change this, arguing that most of the time people hear in their heads “three dee.” And in certain contexts it just sounds odd to spell it out: For example, “three-dimensional television” seems to refer to the object rather than the technology.

I don’t think there’s an explicit policy on “3-D” vs. “3D” throughout [IEEE] and all [its] societies. I have found that the IEEE Computer Society has its own style guide: <http://www.computer.org/portal/web/publications/styleguide> and they have indeed adopted the no-hyphen style.

With regard to publications from the Society for Information Display (SID), Jay Morreale,<sup>4</sup> Managing Editor of the Journal of the SID (JSID) wrote:

In both [Information Display] Magazine and JSID, we have been using “3-D” since ID’s inception in 1987 and since I became Managing Editor of the Journal back in 1978. My goal is to be consistent until the style dictates a change.

As far as references are concerned, it is policy NOT to change references because it is understood that searches need to be based on “original” paper titles, although I must admit the urge is definitely there to edit the titles of papers in the references.

John Dennis,<sup>5</sup> the editor of the National Stereoscopic Association magazine *Stereo World*, said:

We follow a style of using “3-D” in articles except when “3D” is used as part of a movie or book title or product name.

Most newspapers use the “3-D” style – although there are some exceptions, or even inconsistencies within the same publication or article. Most newspapers appear to follow *The Associated Press Stylebook*,<sup>6</sup> which recommends the “3-D” form. In contrast, *The Yahoo! Style Guide*,<sup>7</sup> which is primarily intended for online publishing, recommends the “3D” form.

SPIE does not apply a preferred style of either “3-D” or “3D” in their proceedings or journals. In the proceedings volumes, the authors are free to choose the form they wish. The same is intended to apply to their journals, however my experience is that well-meaning sub-contracted proof editors often apply “3-D” style unless the author makes a representation otherwise.

The editor of *SPIE Professional*, Kathy Sheehan,<sup>8</sup> wrote:

Our magazine generally follows AP style. We have a small style list that sometimes over-rides the AP style, which we do in the case of “3D”. Although we would edit an author’s copy, we would not change the name of a previously published book title, article, etc.

Mark Fihn,<sup>9</sup> editor of *3rd Dimension* newsletter, wrote:

We try to always use “3D”. We don’t give authors any sort of style guide, so we get inputs using either “3D”, “3-D”, or both.

I [usually] do a final edit to change “3-D” to “3D”.

We use “3D” because frequently there’s another hyphen in the equation, such as “3D-enabled” or “pseudo-3D” or some such... It seems awkward to have “3-D-enabled” or “pseudo-3-D”

*The evolution of language*

Languages evolve over time. Strunk and White<sup>11</sup>, in their book “*The Elements of Style*,” wrote: “Do not use a hyphen between words that can better be written as one word: water-fowl, waterfowl. Common sense will aid you in the decision, but a dictionary is more reliable.” and particularly “The steady evolution of the language seems to favor union: two words eventually becoming one, usually after a period of hyphenation.”

A survey of 1293 stereoscopic focused papers<sup>10</sup> published by SD&A, IS&T and SPIE over the period 1977-2009 reveals a trend towards the use of the non-hyphenated form. It is important to note that a house style was not applied to these papers so this provides a good unbiased survey of usage amongst a scientific audience. The survey is broken down into roughly decade-long periods:

- 1977-1989: (231 papers containing 1567 pages)
  - “3D” 921 instances in 91 papers
  - “3-D” 1623 instances in 131 papers
- 1990-1989: (407 papers containing 3535 pages)
  - “3D” 3318 instances in 307 papers
  - “3-D” 2003 instances in 165 papers
- 2000-2009: (655 papers containing 6229 pages)
  - “3D” 11627 instances in 573 papers
  - “3-D” 2827 instances in 263 papers

These statistics are illustrated in Figure 1 and Figure 2:

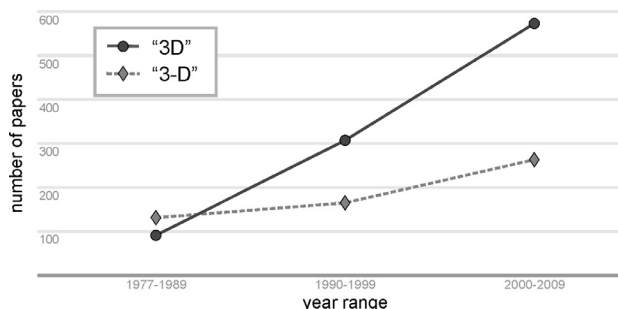


Figure 1: Number of papers in the SD&A 20-year DVD-ROM<sup>10</sup> containing the term “3D” or “3-D” in roughly decade period groups.

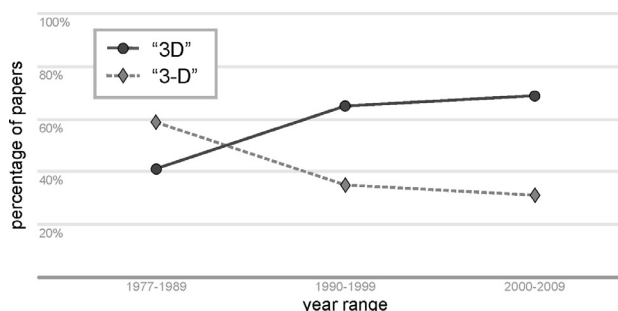


Figure 2: Percentage of number of papers in the SD&A 20-year DVD-ROM<sup>10</sup> containing the term “3D” or “3-D” in roughly decade period groups.

According to this publication record, the “3-D” form was favoured in the 70s and 80s, but over the past couple of decades the unhyphenated “3D” form has become more favoured by scientific authors.

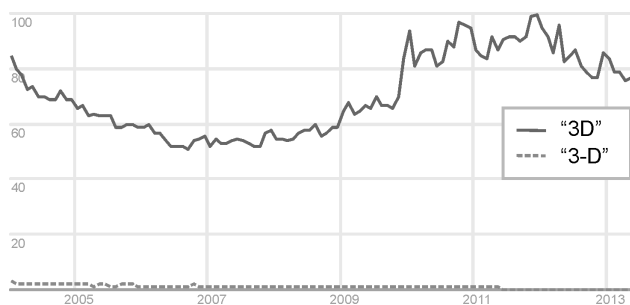
Our next statistic considers the occurrence of “3D” and “3-D” in the May (or April) 2013 issue of several professionally produced publications relevant to the 3D field. Table 1 summarizes counts of “3D” and “3-D”. The count is conducted separately for the text of the publication, which will be affected by the publication’s house style, and in advertisements (adverts), which will not be affected by the publication’s house style.

**Table 1: The occurrence of “3D” and “3-D” in various publications. Values greater than 50% are shown in bold.**

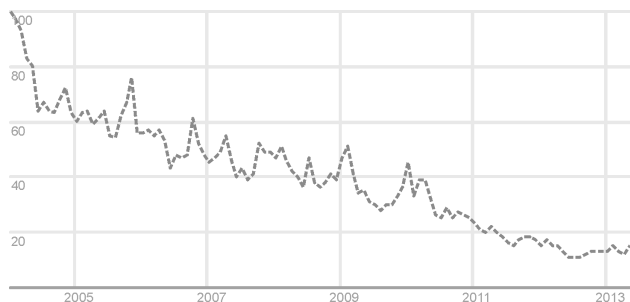
Publication	Occurrences (count) percentage %			
	in text		in adverts	
	“3-D”	“3D”	“3-D”	“3D”
Stereo World <sup>12</sup>	<b>(88)</b> <b>79%</b>	(24) 21%	(12) 14%	<b>(76)</b> <b>86%</b>
Information Display <sup>13</sup>	<b>(103)</b> <b>82%</b>	(23) 18%	(0) 0%	<b>(9)</b> <b>100%</b>
IEEE Spectrum <sup>14</sup>	<b>(3)</b> <b>100%</b>	(0) 0%	(0) 0%	<b>(2)</b> <b>100%</b>
SPIE Professional <sup>15</sup>	(1) 7%	<b>(14)</b> <b>93%</b>	(0) 0%	<b>(2)</b> <b>100%</b>
i3 <sup>16</sup>	(0) 0%	<b>(76)</b> <b>100%</b>	(0) -	(0) -
3rd Dimension <sup>17</sup>	(10) 1%	<b>(718)</b> <b>99%</b>	(0) 0%	<b>(2)</b> <b>100%</b>

It can be seen that, not surprisingly, the “3-D” form predominates in the text of the three publications identified earlier which apply a house style of “3-D”. Perhaps tellingly, the occurrence of the non-hyphenated form “3D” predominates in the advertisements appearing in those same publications – indicating the preference of the advertisers or their marketing consultants for the non-hyphenated form. The latter three publications, which are all significantly younger than the earlier three publications, all have a predominance of the “3D” form.

Another statistic that sheds some light on common usage is the incidence of “3D” and “3-D” in Google Searches<sup>18</sup> conducted by the general public as illustrated in Figure 3 and Figure 4.



**Figure 3: Incidence of “3D” and “3-D” in Google Search statistics plotted together. “3-D” peak is only ~3% of “3D” peak. The number 100 represents the peak search interest.**



**Figure 4: The incidence of “3-D” in Google Search statistics plotted in isolation. 100 represents peak search interest.**

Figure 3 reveals that the general public strongly favours “3D” over “3-D” approximately 100:1 in 2013. Although the volume of searches using the term “3D” has had a bit of a wave, over a 9-year period the volume of searches has been fairly steady. Figure 4 reveals that the volume of searches for “3-D” has experienced a heavy decline. These statistics almost function as a popular vote, but importantly reveal that publications using the “3-D” form will miss hits from the vast majority of searches for the “3D” form (unless the search engine automatically combines “3D” and “3-D” results).

**Discussion**

One could argue that the use of the hyphen in the “3-D” abbreviation is unnecessary. An abbreviation is after all meant to be short, and in this instance the hyphen doesn’t add anything vital to the abbreviation. Furthermore, when “3D” and “3-D” are read aloud, they both sound the same anyway.

As mentioned earlier, some terms already include hyphenation (eg 3D-Ready, 3D-capable, 3D-Con) – the addition of another hyphen for the “3D” in these terms would produce an awkward result. A similar thought applies to extended acronyms such as “3DTV” – “3-DTV” seems awkward.

Regardless of an author’s own preference, when writing a manuscript, he or she should be careful that proper nouns are used in the form defined by the originator (eg “Blu-ray 3D”, not “Blu-ray 3-D”). When citing references, authors should be careful to quote the title exactly as written in the original paper (with or without hyphens) – a change in hyphenation could break automatic citation listing. The hyphenation of email addresses and web addresses should also not be changed – otherwise they may simply be broken. Finally, when authors are checking their manuscript proof before publication, they should be sure to check that the hyphenation of proper nouns, references, web addresses and email addresses have not been changed in the proof editing process - a simple search and replace is tempting but can break all of these items.

It was mentioned earlier that there is some desire to differentiate stereoscopic 3D from other uses of 3D by using the abbreviation “s3D” or “S3D”. Additionally, some authors have suggested that “3-D” could be used for stereoscopic specific discussions, and “3D” used for non-stereoscopic uses.<sup>19</sup> Although this proposal does have some merit, this particular style is not currently in widespread use, and differs from the styles required by most publications.

**Conclusion**

Is it time to change the conventions and house styles that require the use of the hyphenated form of “3-D”? I propose that the statistics revealed in this paper show the time is right to make that change.

Giving Lenny Lipton,<sup>20</sup> author of “Foundations of the Stereoscopic Cinema,”<sup>21</sup> the last word:

You cannot imagine how passionate some people are about the hyphen. Or maybe you can. Simpler is better and how does 2-D look to you?

References are listed at the bottom of page 62.

## Essays

### Journal Impact Factor: “the poor man’s citation analysis” and alternative approaches

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**Abstract** The Journal Impact Factor has a number of drawbacks preventing its use for assessment of separate journal articles and individuals. With that in mind, most experts would endorse the San Francisco Declaration on Research Assessment (DORA), which highlights the appropriate use of bibliometric indicators for quantitative research assessments. To curb the problem of skewed citations, an alternative, normalised metric is proposed. Percentiles, or percentile rank classes method, is particularly useful for normalisation. It is also advisable to use specific percentile rank classes and to assess individual scientists with  $P_{\text{top } 10\%}$  or  $PP_{\text{top } 10\%}$  indicators.

**Keywords** Bibliometrics; research evaluation; alternative metrics.

In the process of quantitative (bibliometric) research evaluation, citation analysis may be erroneously replaced by the use of the journal impact factor (JIF).<sup>1</sup> This is unacceptable, since the JIF is merely an impact measure for scholarly journals. It was originally proposed to help

librarians distinguish influential journals of interest to their readership, but not to evaluate a single paper in a journal or research performance of a scientist.<sup>2</sup>

Experts in bibliometrics are well aware that the JIF has a number of drawbacks preventing its use for research assessment. Most importantly, the distribution of citations to a journal’s articles is often highly skewed since a large number of citations go to a few items in the journal. As a result, citation rates are influenced by a small fraction of highly cited items. The JIF’s timeframe (two years) is often too short for comprehensive evaluation of a journal performance in slowly developing disciplines. Adjustment of citation behaviour for disciplines, cross-disciplinary comparisons and comparisons of journals publishing predominantly certain types of articles (eg reviews, original research papers) are impossible with the use of JIF.

Anthony van Raan once noted that “if there is one thing every bibliometrician agrees, it is that you should never use the journal impact factor to evaluate research performance for an article or for an individual — that is a mortal sin.”<sup>3</sup>

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