

This document is my proposal for a presentation at DOCAM '05, October 7-9.

Title: Clownpants in the Classroom? Entropy, Humor, and Distraction in Multimedia Instructional Materials

Keywords: Information Theory, Entropy, Multimedia Documents, PowerPoint

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Papers: The manuscript from which this synopsis comes has been submitted for publication and is yet in the review process.

Type: This presentation will be verbal and visual with the use of PowerPoint. I will need data projector to connect to my notebook computer.

Research Description

Dancing with Entropy (Kearns & O'Connor, 2004) describes how “creating surrogates [for enriching document representations logically for specific users] is like dancing with entropy” because the creator assumes to know some things about the user and the user of the creator in order that the dance is seamless and smooth. Without some assumed knowledge of each other, information retrieval cannot be a [decipherably noisy] channel of communication (Blair, 1990). Kearns & O'Connor (2004) attempt to extricate the dance by matching users' perceived entropy values (PEM) to calculated entropy measurements (CEM), where entropy (H) is defined by Shannon's (1949) equation in The Mathematical Theory of Communication:

$$H = - \sum_{i=1}^k p_i * \log_2(p_i)$$

Entropy measurements show the amount of surprise and unpredictableness of form attributes of a document, as is true also in comedy and parody. The provocative relationship between entropy and humor is explored in the application of the equation to form attributes of PowerPoint documents engineered by pre-service teachers. I measured ten entropies (defined in the equation interpretations of Table 1) for commonly used (over-used, and misused) tools and features of PowerPoint. The CEMs of these PowerPoint attributes (see Table 2) show that high entropy moments in PowerPoint presentations are those instances when the creator surprises the audience with PPT features that stray from what the audience has perceived as *normal* for that presenter; these instances of surprise within a presentation are called *entropic bursts*. When the engineer attempts to fill the PPT presentation with entropic bursts, he or she is merely changing the baseline scale of *normal* or *regular* for that PPT presentation and consequently altering the pretence under which the entropic burst can occur, thusly, like in joke telling, eliciting from the audience a willing suspension of disbelief of what may be normal through audial and temporal signals.

The CEMs of PPT form attributes provide useful information for the designer of a presentation – as the comedian attempts to do for his audience – by building in moments of surprise that are still relevant to the communication. To add additional practical application of this entropy dance, I used the CEMs to determine distraction factors for specific presentation features, as in how distracting is the engineered text entry animation of individual letters flying in with a whirl, accompanied by the sound of clicking typewriter keys, on every slide?

$$DF = \left(\left| 0.5 - H \right| \right) * 20$$

when

$$H = - \sum_{i=1}^k p_i * \log_2(p_i)$$

From this Distraction Factor (DF) formula we conceive an actual numerical measurement that defines – on the familiar scale of 1 to 10 – how distracting from the content are the engineered elements of a presentation. When DF is high, we call this clownpants, whether the distraction results from too much or too little physical information, since no-pants can be as distracting as

clownpants. Consider the Sound Effect Entropy measurements (see Table 3) for Subjects 6 and 11 as 0: the resulting distraction factors from this low-entropy component are perfect tens ($DF_{SE}=10$) on the Clownpants Index (CPI.)

If distraction factors of all physical attributes are all high, or all are low, no emphasis has been made. The PPT designer has merely delivered content flatly, and likely as effectively as reading that content from the text with no vocal inflections, similar to Bob Ross in the Joy of Painting delivers his painting descriptions in one continual tone (Kearns & O'Connor, 2004). Some distraction is good because it creates emphasis. Building "distractions" or surprises onto every slide, makes your information predictable, but noticing *discontinuities* (Augst & O'Connor, 1999) or *change in visual fields* (Watt, 1979) generates higher viewer attention.

Predicting CPI for the specific audience can be tricky because, as teachers, they will need to understand how to engineer PPT presentations with low distraction factors. Building entropic bursts can help create the necessary emphasis and cue for students to commit content to their memories. That is, implementing an essential balance between information and content to most effectively and affectively deliver a lesson. Finding this balance will be like a "dance" (Kearns & O'Connor, 2004, p. 146), perhaps a "tango" (Augst & O'Connor, 1999, p. 346), where both partners in the communication must assume that knowledge of the other. This study centers on PPT presentations, and encouraging an intentional, safe balance between PPT form and content attributes.

References

- Augst, B. & O'Connor, B. (1999). "No longer a shot in the dark: Engineering a robust environment for film study." *Computers and the Humanities*, Vol. 33, No. 4, 345-363.
- Blair, D. C. (1990). Language and representation in information retrieval. Amsterdam: Elsevier Science Publishers.
- Idle, E. (1999). *The road to mars*. (New York: Pantheon Books.)
- Kearns, J. and O'Connor, B. C. (2004). "Dancing with Entropy: Form Attributes, Children, and Representation." *Journal of Documentation*, Vol. 60, No. 2, 144-163.
- Shannon, C. & Weaver, W. (1949). *The mathematical theory of communication*. (Urbana: The University of Illinois Press.)
- Watt, J. (1979) "Television form, content attributes, and viewer behavior". In M. J. Voight's *Progress In Communication*, (Norwood, NJ: ALEX Publishing), pp. 51-89.

Appendix of Tables

Table 1

Entropy Type	Formula Interpretations for PPT Presentation Attributes	Description
HCO Color Incidence Entropy	$HCO = - \frac{\sum_{i=1}^k \frac{n_{colorpage}}{n_{pixels}} * \log_2 \frac{n_{colorpage}}{n_{pixels}}}{n_{slides}}$	where $n_{colorpage}$ is the total number of colors appearing on each page n_{pixels} is the total number of pixels per slide n_{slides} is the total number of slides in the presentation
HCR Color Range Entropy	$HCR = - \frac{r_{color}}{n_{pixels}} * \log_2 \frac{r_{color}}{n_{pixels}}$	where r_{color} is the color range of the total presentation n_{pixels} is the number of pixels per slide
HTI Transition Incidence Entropy	$HTI = - \frac{n_{transitiontypes}}{n_{slides}} * \log_2 \frac{n_{transitiontypes}}{n_{slides}}$	where $n_{transitiontypes}$ is the number of different slide transition effects used in the presentation n_{slides} is the total number of slides in the presentation
HSE Sound Effects Entropy	$HSE = - \frac{n_{sounds}}{n_{slides}} * \log_2 \frac{n_{sounds}}{n_{slides}}$	where n_{sounds} is the number of sounds and sound effects in the presentation n_{slides} is the total number of slides in the presentation
HAD Animation Distribution Entropy	$HAD = - \frac{\sum_{i=1}^k \frac{n_{slideanimationevents}}{n_{totalanimations}} * \log_2 \frac{n_{slideanimationevents}}{n_{totalanimations}}}{n_{slides}}$	where $n_{slideanimationevents}$ is the number of animation events per slide $n_{totalanimations}$ is the total number of animation events in the presentation n_{slides} is the total number of slides in the presentation
HWI Word Incidence Entropy	$HWI = - \frac{\sum_{i=1}^k \frac{n_{wordperslide}}{n_{slides}} * \log_2 \frac{n_{wordperslide}}{n_{slides}}}{n_{slides}}$	where $n_{wordperslide}$ is the number of words appearing on individual slides n_{slides} is the total number of slides in the presentation

HWP Weighted Picture Entropy	$HWP = -\frac{t_{anticipated}}{n_{pictures}} * \log_2 \frac{t_{anticipated}}{n_{pictures}}$	where $t_{anticipated}$ is the total amount of time anticipated as the goal for the presentation* $n_{pictures}$ is the total number of pictures, images, graphics in the presentation
HVT Transition Variance Entropy	$HVT = -\frac{n_{transitiontypes}}{n_{transitions}} * \log_2 \frac{n_{transitiontypes}}{n_{transitions}}$	where $n_{transitiontypes}$ is the number of different slide transition effects used in the presentation $n_{transitions}$ is the number of transitions used in the presentation
HWT Weighted Text Entropy	$HWT = -\frac{t_{anticipated}}{n_{words}} * \log_2 \frac{t_{anticipated}}{n_{words}}$	where $t_{anticipated}$ is the total amount of time anticipated as the goal for the presentation n_{words} is the total number of words in the presentation
HAI Animation Incidence Entropy	$HAI = -\frac{\sum_{i=1}^k \frac{n_{slideanimationevents}}{n_{totalanimations}} * \log_2 \frac{n_{slideanimationevents}}{n_{totalanimations}}}{n_{animatedslides}}$	where $n_{slideanimationevents}$ is the number of animation events per slide $n_{totalanimations}$ is the total number of animation events in the presentation $n_{animatedslides}$ is the number of slides containing animation effects

Table 1: Calculating Entropy of 10 PPT Form Attributes

Table 2

	HCO	HCR	HTI	HSE	HAD	HWI	HWP	HVT	HWT	HAI
Subject 01	0.212040	0.278344	0.136803	0.464386	0.287803	0.301378	0.127721	0.352214	0.294357	0.313543
Subject 02	0.124237	0.407826	0.136803	0.464386	0.102033	0.288973	0.471466	0.000000	0.141349	0.459148
Subject 03	0.113362	0.100435	0.125003	0.000000	0.158496	0.215401	0.406696	0.332193	0.196096	0.528321
Subject 04	0.257731	0.440185	0.257542	0.464386	0.222204	0.269334	0.526264	0.375000	0.228350	0.381891
Subject 05	0.176343	0.181259	0.136803	0.360201	0.273162	0.282642	0.379933	0.352214	0.528321	0.351208
Subject 06	0.137513	0.152921	0.115070	0.000000	0.301993	0.326368	0.398284	0.314494	0.102062	0.332193
Subject 07	0.260740	0.337757	-	0.442179	0.325755	0.269488	0.530197	-	0.162417	0.326089
Subject 08	0.202271	0.202089	0.115070	0.430827	0.000000	0.303270	0.509709	0.447169	0.207830	-
Subject 09	0.181788	0.178987	0.464386	0.464386	0.293512	0.291733	0.524397	0.000000	0.186785	0.377372
Subject 10	0.080849	0.081689	0.125003	-	0.200000	0.299320	0.389975	0.332193	0.101928	0.500000
Subject 11	0.331380	0.405602	0.136803	0.000000	0.324255	0.316827	0.358737	0.352214	0.285992	0.324255
Subject 12	0.130634	0.144083	0.136803	-	0.332193	0.320398	0.460882	0.352214	0.194947	0.332193
Subject 13	0.234687	0.368842	0.360201	0.442179	0.295296	0.268548	0.398284	0.461346	0.153525	0.331692
Subject 14	0.094310	0.105634	0.115070	0.430827	0.083481	0.322787	0.430827	0.517047	0.102331	0.459148
Subject 15	0.139485	0.177751	0.136803	0.464386	0.100729	0.323142	0.450548	0.352214	0.129748	0.456984
Subject 16	0.189033	0.176744	0.257542	0.442179	0.324327	0.294758	0.450548	0.311278	0.276878	0.326083
Subject 17	0.160468	0.220355	0.125003	0.530702	0.105664	0.320082	0.510142	0.528771	0.169159	0.528321

Subject 18	0.125465	0.260769	-	0.464386	0.331190	0.285091	0.450315	-	0.133048	0.331190
Subject 19	0.137047	0.253482	0.125003	0.447169	0.290311	0.276898	0.379933	0.500000	0.153860	0.290311
Subject 20	0.287712	0.368373	0.136803	0.332193	0.333058	0.293076	0.506842	0.151044	0.482206	0.322110
Subject 21	0.223025	0.412018	0.115070	0.526264	0.276181	0.304774	0.345939	0.000000	0.177482	0.312640
Subject 22	0.179282	0.237741	0.125003	0.511219	0.167674	0.275158	0.510142	0.332193	0.159448	0.419184
Subject 23	0.157680	0.173561	0.115070	0.528321	0.273299	0.305678	0.367845	0.000000	0.261560	0.320899
Subject 24	0.148267	0.417103	-	0.332193	0.250181	0.000000	0.521959	-	0.306397	0.450326

Table 2: Entropy Calculations of 10 PPT Form Attributes of Presentations Designed by 24 Pre-Service Teachers

Table 3

	DF _{co}	DF _{cr}	DF _{ti}	DF _{se}	DF _{ad}	DF _{wi}	DF _{wp}	DF _{vt}	DF _{wt}	DF _{ai}
Subject 01	5.75920	4.43312	7.26394	0.71228	4.24394	3.97244	7.44558	2.95572	4.11286	3.72914
Subject 02	7.51526	1.84348	7.26394	0.71228	7.95934	4.22054	0.57068	10	7.17302	0.81704
Subject 03	7.73276	7.99130	7.49994	10	6.83008	5.69198	1.86608	3.35614	6.07808	0.56642
Subject 04	4.84538	1.19630	4.84916	0.71228	5.55592	4.61332	0.52528	2.5	5.43300	2.36218
Subject 05	6.47314	6.37482	7.26394	2.79598	4.53676	4.34716	2.40134	2.95572	0.56642	2.97584
Subject 06	7.24974	6.94158	7.69860	10	3.96014	3.47264	2.03432	3.71012	7.95876	3.35614
Subject 07	4.78520	3.24486	-	1.15642	3.48490	4.61024	0.60394	-	6.75166	3.47822
Subject 08	5.95458	5.95822	7.69860	1.38346	10	3.9346	0.19418	1.05662	5.84340	-
Subject 09	6.36424	6.42026	0.71228	0.71228	4.12976	4.16534	0.48794	10	6.26430	2.45256
Subject 10	8.38302	8.36622	7.49994	-	6	4.01360	2.20050	3.35614	7.96144	0
Subject 11	3.37240	1.88796	7.26394	10	3.51490	3.66346	2.82526	2.95572	4.28016	3.51490
Subject 12	7.38732	7.11834	7.26394	-	3.35614	3.59204	0.78236	2.95572	6.10106	3.35614
Subject 13	5.30626	2.62316	2.79598	1.15642	4.09408	4.62904	2.03432	0.77308	6.92950	3.36616
Subject 14	8.11380	7.88732	7.69860	1.38346	8.33038	3.54426	1.38346	0.34094	7.95338	0.81704
Subject 15	7.21030	6.44498	7.26394	0.71228	7.98542	3.53716	0.98904	2.95572	7.40504	0.86032
Subject 16	6.21934	6.46512	4.84916	1.15642	3.51346	4.10484	0.98904	3.77444	4.46244	3.47834
Subject 17	6.79064	5.59290	7.49994	0.61404	7.88672	3.59836	0.20284	0.57542	6.61682	0.56642
Subject 18	7.49070	4.78462	-	0.71228	3.3762	4.29818	0.99370	-	7.33904	3.37620
Subject 19	7.25906	4.93036	7.49994	1.05662	4.19378	4.46204	2.40134	0	6.92280	4.19378
Subject 20	4.24576	2.63254	7.26394	3.35614	3.33884	4.13848	0.13684	6.97912	0.35588	3.55780
Subject 21	5.53950	1.75964	7.69860	0.52528	4.47638	3.90452	3.08122	10	6.45036	3.74720
Subject 22	6.41436	5.24518	7.49994	0.22438	6.64652	4.49684	0.20284	3.35614	6.81104	1.61632
Subject 23	6.84640	6.52878	7.69860	0.56642	4.53402	3.88644	2.64310	10	4.76880	3.58202
Subject 24	7.03466	1.65794	-	3.35614	4.99638	10	0.43918	-	3.87206	0.99348

Table 3: Distraction Factors Calculated for 10 Form Attributes of 24 PPT Presentations